DIVISION OF FISH AND GAME OF CALIFORNIA

BUREAU OF MARINE FISHERIES

FISH BULLETIN No. 54

The Fishes of the Family Sciaenidae (Croakers) of California

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1939

76680

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THE FISHES OF THE FAMILY SCIAENIDAE (CROAKERS) OF CALIFORNIA[1]

By TAGE SKOGSBERG, *Hopkins Marine Station, Stanford University*

INTRODUCTION

The sea along the extensive coast line of California is the home of a large number (about 500) of different kinds of fishes. The California fresh and brackish waters are comparatively restricted, but even so their fish fauna is very interesting and important in spite of the comparatively limited number of species occurring in these habitats. In California the commercial fisheries are so highly developed that they rank among the largest in the world. And, last but not least, there is in this State a very large number of sport fishermen who seek and find their recreation through a variety of different types of fishing, along the rivers and streams, in the lakes, and on the coastal piers, rocks and sandy beaches, as well as at sea near the coast.

In spite of these facts, published information on the fishes of this State is very incomplete and, in addition, too scattered to be easily available. Most of the species undoubtedly have been described and some of the most important commercial ones have been thoroughly investigated; but, taken as a whole, the field of the California fishes is much in need of extensive reviewing and exploration. An unknown fish can in most cases be identified with the help of Jordan and Evermann's large monograph, "The Fishes of North and Middle America," but this splendid work does not fill the purpose of a handbook for several reasons: first, it is almost purely taxonomic and each species is dealt with very briefly; second, it includes the fishes of the entire North American continent which frequently makes the identifications very difficult; third, only comparatively few of the California species are figured; fourth, it was published about forty years ago and much information bearing on this subject has been accumulated in these years; and, fifth, it is quite rare and thus available to only a comparatively small number of people.

The situation has become somewhat improved of late years. In 1931, Walford's "Handbook of Common Commercial and Game Fishes of California" was published by the California Division of Fish and Game. This excellent little book is a splendid guide in the determination of the commercial catch and of the species on which the sportsmen specialize. In it are to be found, besides photographs and the main characteristics of the species concerned, brief notes on the systematic position, distribution, fishing season, gear, and commercial or game significance. Barnhart's (1936) "Marine Fishes of Southern California" deals with its material somewhat less fully than does Jordan and Evermann's monograph, but, nevertheless, serves a useful purpose. In 1937, Walford's "Marine Game Fishes of the Pacific Coast from

[1] Submitted for publication, 1937.

Alaska to the Equator'' was published. Although this book is beautifully illustrated and contains much new information, nevertheless, it demonstrates clearly the truth of the author's statement in the introduction (Walford, 1937, p. XXVII) that, ''Apart from the names of many of the game fishes and their external and internal anatomy, we know very little about them.'' With few exceptions there is little known about the habits and life-histories of the California fishes.

In brief, there is a real need for a handbook of the fishes of California in which every form is dealt with as fully as possible. The preparation of such a handbook, however, is a tremendous undertaking which can not be handled by any one person unless he is willing and able to devote an entire lifetime to this task. No person with these qualifications being available at present, we must seek to reach our goal by the cooperative method. According to this plan, each co-worker would select one or a few families as his particular specialty; and after all the fishes have been thus studied and the results published, the various papers would be condensed and assembled into a handbook. Cooperation of this kind requires that the various specialists deal with their groups according to standardized principles, otherwise the final material would be difficult to synthesize.

Having decided upon this plan as the most practical and feasible, the writer of this paper attempted to treat of the family Sciaenidae, one of the many families of the California fishes, in such a manner that the results could be used as a model for other contributions toward the proposed handbook. Circumstances prevented him from doing intensive and extensive studies in the field, especially in regard to the difficult chapter on the breeding habits and life-histories, but he plans to accumulate information of this kind in the years to come and to record and store it in such a manner that it will be readily available to whomsoever will become the editor of the handbook.

The most outstanding feature of the treatment of the material presented in this paper is the strict standardization of diagnoses and descriptions. All the characters are treated in a standard sequence and, as far as possible, in the same terminology. This strictness has been adopted in order to facilitate comparisons. In the arrangement of the characters the most logical order has been sought: first, the general shape of the body; second, the external features of the head; third, the external features of the rest of the body; fourth, the internal features of the head; and, fifth, the internal features of the rest of the body. Then follow the coloration and size, a series of proportions, and finally a statement as to the number and sizes of the specimens examined. The last information is of importance since it will enable the reader to evaluate the proportions. Even though comparatively long, the descriptions are as condensed as clarity permits. Completeness in description is necessitated by the inherent variability of the species, and it is also essential in order to make it possible for the student to establish whether local races or geographical subspecies may exist.

The following principles of taking the data should also be emphasized:

1. The standard length is the shortest distance between the tip of the head and the end of the last vertebra (inclusive of urostyle); it is thus not measured along the curvature of the body.

2. Measurements to obtain the proportions of the different parts of the body proper should preferably be made (as they were in the case of the present paper) with the type of measuring machine described by Thompson (1917, 1926).

3. The length of caudal fin is measured from posterior end of last vertebra to tip of longest caudal lobe when this is held straight back.

4. Measurements of other fins made with a pair of dividers; in other words, these are also straight line measurements.

5. Lengths of snout and eye measured with a pair of dividers held in the planes in which these structures lie.

6. Scales above lateral line counted along shortest row of scales between lateral line and a point just behind anterior end of first dorsal. Scales below lateral line counted in a similar manner somewhat behind the base of pectorals.

7. Contrary to common usage, the lengths of the fins are expressed in standard length of body. This has been done in order to make them more easily comparable.

8. In order to facilitate an accurate examination, the jaws, gill rakers and pharyngeals were dried before examination.

9. Vertebral counts are exclusive of the urostyle.

The general arrangement of the treatment of each species is about the same as used by Bigelow and Welsh (1925).

Finally, I wish to thank the members of the California State Fisheries Laboratory for aid in collecting material, and Mr. W. L. Scofield and Dr. Frances N. Clark for the help which they have given me during the preparation of this paper. In regard to the information concerning sport fishing of the croakers, I am much indebted to two persons, Mr. Joseph H. Wales, Bureau of Fish Conservation, Division of Fish and Game, who during his residence in southern California was an ardent sport fisherman, and Mr. Richard S. Croker, who is in charge of the inquiry into ocean sport fishing carried on by the California Division of Fish and Game. To both of them, I wish to acknowledge my sincere thanks. The photographs of the species treated in this report were made by commercial photographers for the California State Fisheries Laboratory. Four of these photographs were retouched by Mr. Charles A. Dawson of Pasadena, California, viz., those of the queenfish, the short-fin sea-bass, the California corbina and the black croaker. The retouching of the remaining species was carried out by myself. I am happy to thank Mr. Dawson in this connection for his skilled work.

FAMILY SCIAENIDAE

Croakers

Diagnosis: Body oblong to rather elongate, more or less compressed. Head prominent. Mouth small to large. Maxillary slipping under free edge of suborbital, which usually is broad. Premaxillary protractile, but not very freely movable. Nostrils double. Snout and chin usually with pores; snout often with slits; chin sometimes with one or more barbels. Suborbital bones without a backward projecting "stay." Preopercle serrate or not. Opercle usually ends in two flat points. Gill membranes separate, free from isthmus. Gill slits 4, a small slit behind fourth. Gill rakers usually present. Pseudobranchiae usually large, present in most genera. Teeth in 1 or 2 series, or closely set in villiform bands; the outer sometimes enlarged; canines sometimes present; no incisors nor molar teeth; no teeth on vomer, palatines, pterygoids nor tongue. Lower pharyngeals separate or united, often enlarged; their teeth conic or molar. Bones of skull cavernous; muciferous system highly developed; surface of skull, when flesh is removed, very uneven. Maxillary without supplemental bone. Branchiostegals, 7. Ear bones (otoliths) large. Dorsal fin deeply notched or divided into 2 fins; second dorsal the longer; spines depressible into a more or less distinct groove. Pectoral fins normal. Pelvic fins, I, 5; thoracic, below or behind pectorals. Anal fin with 1 or 2 spines. Caudal fin usually not forked. Lateral line continuous, usually more or less concurrent with back, extending on caudal fin. Scales rather thin, usually more or less ctenoid and nondeciduous; head and lateral line of tail fin scaly. Pyloric caeca usually rather few (less than 15). Air bladder present, except in *Menticirrhus;* usually large and complicated. Mostly marine; a few in fresh water. All the California species are marine.

(This diagnosis is largely a rearrangement of the one given by Jordan and Evermann, 1898, p. 1392.)

Sciaenidae is quite an extensive and diversified family, including a large number of species, divided, according to Jordan (1923, pp. 201-202), among not less than 84 recent genera, many of which are so closely related that their definitions offer great difficulties. Even the delimitation of the family is fraught with complications. In Jordan (*loc. cit.*), the family is divided into two, viz., Sciaenidae and Otolithidae. Of the genera dealt with in this paper, *Seriphus* and *Cynoscion* should belong to Otolithidae, the remaining ones to Sciaenidae. Sciaenidae should be characterized by 10 + 14 vertebrae, Otolithidae by 14 + 10. This subdivision has, tentatively, not been followed in the present paper, since the transition between these two groups appears to be nearly gradual and since some of the genera of Otolithidae, e.g., *Seriphus* and *Nebris*, have a vertebral formula of 10 + 14, i.e., the one characteristic of Sciaenidae.

The arrangement of the genera in this report is the same as in Jordan and Evermann (1898). Whether this order is expressive of the evolution of the group and thus of mutual relationships is far from certain. The inter-relationships of the genera have not as yet been studied on the basis of comparative morphology, except in a very superficial manner. At the same time it should be noted that *Seriphus*, which is placed first, in all probability is the most primitive genus and that the second genus, *Cynoscion*, also appears to be quite primitive in many respects. It is the croakers in the restricted sense, i.e., all but the Otolithidae, which offer the greatest difficulty in regard to their evolutionary positions.

The family is nearly limited to warm seas, where most of the species occur along sandy shores. A few species extend into relatively cool waters, but none of them tolerates cold water. Occurrence in fresh water is very rare.

Most of the members of the family are capable of producing a peculiar noise, hence their name "croakers." On the west coast of North America, several of the vernacular names are misleading. Such names as herring, sea trout, tomcod, whiting, etc., which should be

applied to widely different species, are frequently used for some of the California species. In order to avoid further confusion, these names have barely been mentioned in connection with the treatment of the species dealt with in this paper. Only one English name has been given to each species, viz., the one accepted by the California Division of Fish and Game.

Although all the species I have examined are much more variable than shown by Jordan and Evermann (1898), I have not found any indications of races except in the case of the queenfish, and even in this species the evidence is far from conclusive.

Only those species of Sciaenidae which have been recorded in California have been described in the present paper. Other species of the family, viz., *Cynoscion othonopterus* (gulf corbina), *Cynoscion reticulatus* (striped corbina), *Cynoscion xanthulus* (orange-mouthed corbina), and *Cynoscion macdonaldi* (totuava), have appeared more or less recently in our fresh fish markets. These forms, however, are not native in California, but are taken in Mexican waters, mainly in the Gulf of California and are shipped mostly by trucks into California where they are sold extensively in the southern part of the State (Chute, 1928; Craig, 1926; Croker, 1932). In regard to the striped corbina, it must suffice to state that it is not brought into California in commercial quantities. The orange-mouthed corbina also plays a minor role in the fresh fish supply. The most important species are the totuava and the gulf corbina. In order to illustrate the relative significance of these two forms to the fresh fish trade of the State, it may be enough to note that in 1931 the sales records of the gulf corbina showed an amount exceeding 115,000 pounds, while for the totuava the corresponding value was not less than 1,300,000 pounds. Nearly all the fishing is done by means of hand lines and set lines in the fall, winter and spring. The totuava is also appreciated by sport fishermen for its gamy nature.

Although the intensive exploitation of the totuava and the Mexican corbinas is of comparatively recent origin, the increase in this fishery has been so rapid that at present these species form a most important part of the fresh fish trade of southern California. This increase also furnishes quite a convincing evidence of the heavy strain to which the local fish supply of southern California is subjected. Generally speaking, it may be said that the extension of fishing operations into distant waters is a sign of danger. It indicates that the local natural supply is being taxed very heavily; frequently, even that there is an actual decrease in the local yield. Even in the case of a simultaneous, more or less pronounced increase in the local human population, such as has taken place in the region around Los Angeles, a decided increase in the fishing area should be considered as a warning.

In order to demonstrate the growth of the importation of totuava into California (as noted above, most of this fish is consumed in the southern part of the State, even though of late years an increasing percentage has been shipped north), the following facts and statistics concerning this species gathered by the California Bureau of Marine Fisheries may be given. No totuava were recorded in the California fresh fish markets before 1924. It may be of interest to note, however, that before that time large quantities of the species were taken in the Gulf

of California for the sake of the swim bladders which were exported to China, the rest of the fish being allowed to go to waste (Chute, 1928). In the fall of 1924, small trucks began hauling the species to Los Angeles from San Felipe, a camp on the west side of the Gulf near the north end. Better trucks were soon employed, their number increased, and soon the new business assumed large proportions. In table 1, the annual importation of the species is given. Attention should be called to the fact that there is a great deal of uncertainty inherent in these data; especially the values for the first few years are very doubtful. This uncertainty is due to the fact that this supply, being of foreign origin and transported in an unusual manner, has not been so well supervised and its recording so well organized by the Bureau of Marine Fisheries as in the case of the native species or those imported by boats and thus received through the regular channels. Under these circumstances, an unknown quantity naturally escapes being recorded, and, in addition, the catch was at first not properly classified according to species. Thus, for instance, in the beginning no separation between the totuava and the gulf corbina and the other members of Cynoscion was carried through. W. L. Scofield, Supervisor of the California State Fisheries Laboratory, writes in a letter on this point as follows: "I fear this record may have a large percentage of error."

TABLE 1

Annual Importations of Totuava to California

	Pounds
1924	11,460
1925	207,736
1926	796,034
1927	809,558
1928	841,357
1929	859,446
1930	1,808,532
1931	1,169,467
1932	1,126,685
1933	930,314
1934	943,179
1935	1,484,741
1936	1,423,800
1937	1,171,623

Of the members of Sciaenidae occurring in California, only one yields an important supply of commercial food. This is the white seabass. It may be of interest to note in this connection that the natural stock of this species appears to be over-exploited at present. Of the remaining California species, only the kingfish is taken commercially. The value of this catch is quite small and in all probability will continue to be so, due both to the limitation of the natural supply and to the restricted demand. The others are for all practical purposes taken only by sport fishermen.

Most of the members of the family occupy a very prominent position among the sport fishes of California, especially in southern California where they are more or less abundant. The California corbina, the yellowfin, and the spotfin have thousands of devotees among the surf fishermen, the first of these forms undoubtedly being the most popular sport fish in the surf of our southern sandy beaches. Few people, indeed, realize how large an army of sportsmen find their recreation along the beaches of southern California because of the

excellent fighting qualities of these three attractive fishes. Furthermore, among the anglers who specialize in medium sized game fishes, the white sea-bass is one of the most popular species. It is a paradox, indeed, that the two members of the family which have been given regal names, viz., the kingfish and the queenfish, are the least attractive to the sportsmen. The lowliest among them is the kingfish, in which the sportsmen see hardly anything but a nuisance which interferes with their pursuit of desirable species.

All the species, except the kingfish and the queenfish, have been given some legal protection. Among the protected ones, only the white sea-bass is open to commercial exploitation; the others are reserved for sport.

Key to the Genera of Sciaenidae in California

1.	Lower jaw not included, usually projecting beyond tip of snout	2
1–1.	Lower jaw well included	3
2.	The two dorsal fins well separated—*Seriphus*	
2–2.	The two dorsal fins contiguous—*Cynoscion*	
3.	A single barbel at tip of lower jaw	4
3–3.	Either no barbel or several minute barbels at tip of lower jaw	5
4.	Anal fin with 2 strong spines—*Umbrina*	
4–4.	Anal fin with 1 weak spine—*Menticirrhus*	
5.	First dorsal fin with 12 or more spines—*Genyonemus*	
5–5.	First dorsal fin with less than 12 spines	6
6.	Pectoral fin as long as head, with large black spot at its base—*Roncador*	
6–6.	Pectoral fin much shorter than head, without large black spot at its base—*Sciaena*	

SERIPHUS AYRES

Synonymy:[2]

Seriphus Ayres, Proc. Calif. Acad. Sci., 1858-1862, 2:80 (1863; read Nov. 5, 1860) (*S. politus* Ayres).

Diagnosis: Body moderately elongate, much compressed; back fairly rounded; dorsal and ventral sides moderately and usually subequally convex; anterodorsal profile not steep. Head deep, bluntish, carinated below. Mouth very large, terminal, oblique; lower jaw projecting, its symphysis somewhat produced, not included; maxillary broad, its posterior width about 0.5-0.6 of eye. Suborbital area narrow. Margin of preopercle membranous, finely serrate. Snout without slits and large pores; chin without barbels and large pores. Lateral line nearly straight. Dorsal and anal fins moderately high. Dorsal fins well separated; their spines feeble; about 8 or 9 spines in first dorsal; base of second dorsal but slightly, if at all, longer than that of anal. Spines of pectoral, pelvic and anal fins weak. Anal, II, 21-23. Caudal subtruncate to lunate. Scales deciduous, rather large. Head scaly, except ventrally and just in front of eyes and on lips; most of its scales cycloid. Teeth in single row in lower jaw; in double row in upper jaw, except near tip of snout; all small, pointed and slightly bent inward. Lower pharnygeals separate, rather narrow; their teeth pointed. Gill rakers feeble; middle ones long. Pseudobranchiae well developed. Air bladder large. Vertebrae, 10 + 14.

This is apparently the most primitive of all the genera of Sciaenidae, and it evidently occupies a rather isolated position. In the Eastern Pacific, it is represented by only one species, *Seriphus politus*. Judging by the very limited number of measurements at my disposal, this species may consist of two races, viz., one large-headed occurring in southern California and one small-headed limited to central California. Other differences probably exist, but my limited material did not bring them out with perfect clearness.

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[2] The synonymies given are drawn from Jordan and Gilbert (1882), Jordan and Eigenmann (1889), Jordan and Evermann (1898), and Jordan, Evermann and Clark (1930). References to other works are drawn from one or more of the volumes mentioned.

FIG. 1.

SERIPHUS POLITUS AYRES

Queenfish

Synonymy:

Seriphus politus Ayres, Proc. Calif. Acad. Sci., 1858-1862, 2:80, fig. 21 (1863; read Nov. 5, 1860); "no locality," Jordan and Evermann; "about San Diego," Jordan, Evermann and Clark.

Diagnosis: Lower jaw somewhat projecting. Dorsals well apart. D. VIII or IX-I, 18-21. A. II, 21-23. Bluish above, sides and belly bright silvery.

Description: Body deepest somewhere between anterior end and middle of first dorsal; widest somewhere between posterior end of head and middle of first dorsal; greatest depth, 3.8 (3.5-4.0); greatest width, 7.9 (7.0-8.4); Monterey specimens slightly deeper and wider than specimens from southern California. Dorsal and ventral sides usually subequally convex, but either may be slightly more convex than the other. Anterodorsal profile gently concave above eye. Snout moderately long, 3.5 (3.4-3.7) in head. Projection of lower jaw apparently constant, about as in figure 1. Maxillary extends to somewhere between middle of pupil and posterior margin of eye; 2.0-2.1 in head. Lower anterior edge of upper lip on level with middle or lower margin of pupil. Suborbitals, 0.3-0.4 of eye. Serrulations of preopercle do not increase in size ventrally and have weak ossifications; poorly developed along ventral margin. Eye, 1.2-1.4 in snout and 4.2-5.0 in head; somewhat larger, relatively, in small specimens. Snout and chin with minute pores, barely, if at all, visible to naked eye. First dorsal, VIII, seldom IX; first spine, 0.15-0.33 of second, which is 0.7 (0.6-0.9) of third, which is longest; remaining ones decrease in length posteriorly; posterior 0.15-0.25 of third. Second dorsal, I, 20 (18-21); spine, 0.25-0.50 of first ray, which is 0.5-0.7 of second, which may be longest or only 0.8 of third; even the fourth may be slightly the longest; third, fourth, fifth often subequal; remaining ones decrease in length posteriorly; posterior, 0.3-0.4 of longest. Pectorals, I, 16 (15-17); spine, 0.2-0.3 of first ray, which is slightly shorter than second and third; second to fourth or third to fifth longest. Pelvics: spine, 0.3-0.4 of first ray, which is longest and lacks free, thread-like tip; bases of pelvics connected. Anal, II, 22 (21-23); first spine, 0.2-0.4 of second, which is 0.25-0.35 of first ray, which is but slightly, if at all, longer than second and third; remaining rays decrease in length posteriorly; posterior, 0.25-0.35 of longest. Caudal with 17, seldom 15 or 16, well developed rays. 62 (59-64) pores on lateral line of body; 9-11 scales above, 12 or 13 scales below lateral line. Bases of second dorsal and anal scaled.

Upper jaw: Teeth extend along nearly entire premaxillary; posterior very minute; increase gradually in size anteriorly, but even anterior very small; near tip of snout, teeth may be in two rows but often irregularly arranged; a narrow gap at tip of snout into which fits a small knob at symphysis of lower jaw. Lower jaw: Near symphysis, teeth arranged irregularly; all teeth subequal in size, slightly smaller than anterior ones in upper jaw. Gill rakers, 9 (8-10) + 17 (15-19); middle ones, 0.6-0.8 of eye; decrease gradually in size toward both extremities where they are very small, even hard to detect; on inside with numerous, fine teeth, which, in the case of most rakers, are best developed on the little knobs which characterize the rakers of this species. On inside of first arch, 20 (17-22) knobs, each somewhat swollen at tip and there furnished with numerous, fine teeth; most knobs well developed, but some of the distal may be very small and small intercalary ones may also develop. Pharyngeals differ from those of *Cynoscion nobilis* (see Fig. 3C) by being relatively smaller and weaker; no. 4 is shorter and the lower not quite so narrow; teeth on no. 1, anterior ones on no. 2, and median ones on the lower, somewhat enlarged. Pyloric caeca, 7-9, fairly large. Air bladder with simple anterior point.

Color bluish above, sides and belly bright silvery, finely punctate; vertical fins are bright yellow; bases of pectorals dusky.

A small fish, reaching a body length of about 25 cm. (about 10-12 inches).

Proportions (in standard length):

Length of head (specimens from Monterey)	3.5 (3.4-3.6)
Length of head (specimens from San Pedro)	3.2 (3.1-3.4)
Distance from chin to base of pelvics (Monterey)	3.0 (3.0-3.1)
Distance from chin to base of pelvics (San Pedro)	2.8 (2.6-2.9)
Distance from chin to vent	1.6 (1.5-1.6)
Distance from chin to anterior end of anal	1.4-1.5
Distance from chin to anterior end of first dorsal	2.6 (2.5-2.8)
Distance between the two dorsals	8.3 (6.3-10.5)
Depth at posterior end of head	4.0 (3.9-4.2)
Depth at vent	4.3 (4.0-4.7)
Depth of caudal peduncle	10.5 (10.0-11.8)
Length of first dorsal	7.5 (6.5-8.6)
Length of second dorsal	5.1 (4.7-5.7)
Length of pectorals	5.6 (5.0-6.1)
Length of pelvics	6.5 (6.0-6.9)
Length of anal	4.9 (4.5-5.4)
Length of caudal	5.5 (4.6-6.6)
Greatest height of first dorsal	7.4 (6.3-8.9)
Greatest height of second dorsal	7.4 (6.2-8.0)
Greatest height of anal	8.2 (7.3-9.0)

Measurements were made of five specimens from Monterey Bay (body length 17-19 cm.) and 15 specimens from southern California (body length, 11-20 cm.).

General Range: Coast of California and west coast of Lower California, from San Francisco in the north to the vicinity of Cerros Island in the south.

Occurrence in California: This species is common from Point Conception to the Mexican border, less common or rare from Point Conception to San Francisco. The difference in the frequency in the northern and the southern areas undoubtedly is caused by the queenfish being a moderately stenothermal species. The temperatures of the sea water decrease rather abruptly to the north of Point Conception. Later investigations may even prove that there are two races or subspecies, viz., one large-headed form limited to southern California waters and representing the typical form of the species, and one small-headed race found in central California. It should be noticed that Point Conception is a very important zoogeographical point of division; a very great number of animals, both vertebrates and invertebrates, find their northern or southern limit at this point.

In regard to the northern distributional area, it should be noticed that queenfish, in spite of their limited number, are the most common representatives of the family, next to the kingfish, in the waters around Monterey Bay. Occasionally fairly large quantities of this species are taken by the sardine fishermen in this region.

Queenfish prefer shallow waters and sandy bottom; they are frequently seen at or near the surface, but they are also found swimming around near the bottom. In general, one can say that they are relatively small close to the shore and that they become larger as the water increases in depth. They are most abundant in about 10 to 15 and rather rare in about 30 feet of water. In addition, they occur not only along the open coast but also in bays and sloughs; for instance, in San Diego Bay the species is very common. In southern California, queenfish are seen near shore abundantly from late spring to the beginning of the winter, usually in small, dense schools which often stay in shady places close to or under the piers. In the winter, they probably migrate into somewhat deeper waters where they become less available to the sport fishermen. They frequently associate with kingfish and other small fish.

Food: Small shrimps apparently are preferred but worms and small fish are also eaten.

Breeding: Maturity is reached in May and spawning continues throughout the summer months. In Monterey Bay, specimens with a body length of 17 cm. were found to be sexually mature, whereas some of the specimens taken in southern California were found not to have reached sexual maturity even though they had a body length of 20 cm.

Commercial Importance and Sport Fishing: In spite of the fact that the queenfish are quite delicately flavored, they have only a small commercial value. This may in part be due to their relatively small size, but the main reason is undoubtedly the difficulty in catching them in commercially profitable quantities. From December, 1928, through December, 1929, Clark (1930.1) gathered information in the fresh fish markets at San Pedro in order to establish the proportion of queenfish and kingfish in the commercial catch. The results revealed very strikingly the subordinate value of the catch of queenfish. In the total catch of these two species, the queenfish formed on the average only about 1 per cent. The highest recorded percentage was 5.25 which occurred in February. The fact that the highest percentage was found in one of the winter months may possibly be connected with the withdrawal of the queenfish from the vicinity of the shore line where the prevailing surf renders the use of commercial nets more difficult than in the somewhat deeper waters at a moderate distance from the shore. In the markets of Monterey, queenfish are extremely rare. The percentage of queenfish in relation to kingfish is probably higher in San Diego, but at that port the total catch of these two species (they are both recorded by the dealers as "kingfish") is very small. (See also below, the section on the commercial importance of the kingfish.) As the population of southern California increases, the commercial significance of the queenfish may tend to grow, but presumably it will always remain very subordinate.

To the sport fishermen, the queenfish are valuable mainly because they are excellent as live bait. There are a number of reasons for this being so: First, the queenfish are fairly easily available during a very large part of the year; second, they are exceptionally hardy, being able to live for fairly long periods in small receptacles and remaining active on the hook for hours, much longer than most of the other fishes used for this purpose; third, being bottom fish, they remain, while hooked, near the bottom, which is of great importance in the case of halibut fishing, one of the more popular types of fishing from the piers of southern California. A small queenfish, put on the hook alive, is a deadly bait for kelp bass (*Paralabrax clathratus*). It seems to catch the bass when nothing else will. The anglers on the bait boats (carrying live bait) always try to obtain the small queenfish, they call them "herring," which sometimes are mixed with the sardines and anchovies in the tanks.

The most satisfactory method of catching the queenfish, besides the use of various types of nets, such as round haul nets and gill nets applied by the commercial fishermen, is the employment of a special lure in the form of a silvery sinker with one or more triple hooks

attached, which is jerked or jigged up and down. This gear attracts the queenfish which are hooked when they try to bite. Although the queenfish nearly always can be taken in this manner they sometimes can not. On these occasions, they can often be caught with bait, live sardines and anchovies being best, but cut fish also yielding fair results.

Queenfish are taken by anglers almost entirely from piers or from small boats fishing in shallow water. Sometimes big "runs" occur, and it may then be impossible to fish without catching quantities of this species. It is regarded with some favor as a food fish. This is especially true in regard to the larger sizes, i.e., of about one foot in length or somewhat less.

No legal protection is applied to the species.

CYNOSCION GILL

Synonymy:

Cynoscion Gill, Proc. Acad. Nat. Sci. Phila., 1861, *13*:81 (*Johnius regalis* Bloch and Schneider).

Diagnosis: Body elongate, moderately compressed; dorsal and ventral sides moderately and usually subequally convex; anterodorsal profile not steep. Head rather pointed, subconical. Mouth comparatively large, terminal, not very oblique; lower jaw projecting, its symphysis produced, included only posteriorly; maxillary broad, its posterior width sometimes as much as 0.9 of eye. Suborbital area rather narrow. Preopercle with membranous edge usually serrulate, its bone entire. Snout without slits and large pores; chin without barbels and large pores. Lateral line nearly concurrent with back. Dorsal and anal fins moderately high. Dorsal fins closely contiguous, their spines rather slender; about 10 spines in first dorsal; base of second dorsal more than twice longer than that of anal. Spines of pectoral, pelvic and anal fins weak. Anal, I or II, 7-13. Caudal subtruncate to lunate. Scales moderately deciduous, rather small. Head scaly, except ventrally and just in front of eyes and on lips; its scales ctenoid, except below eyes. Teeth not closely set, partly in narrow bands, partly in double or single rows; upper jaw usually with 2 anterior canines, one or both of which may not be enlarged; lower jaw without anterior canines, its posterior teeth larger than the anterior; all teeth sharp, conical and slightly bent inward, most of them rather small. Lower pharyngeals separate, narrow; teeth pointed. Gill rakers rather strong, at least a few of the middle ones fairly long. Pseudobranchiae well developed. Air bladder large. Vertebrae, 14 + 10.

Like *Seriphus*, the genus *Cynoscion* is relatively primitive. There is at least the possibility that while the former genus is rather close to the ancestral form of the family Sciaenidae, in the restricted sense, *Cynoscion* may be fairly similar to the ancestral type of the Otolithidae. (See above, the remarks following the family diagnosis.) However, since this suggestion is based primarily on the vertebral formulae, it must be regarded as tentative only. A very careful and extensive comparative anatomical study must precede a more definite statement in this matter.

The genus comprises a fairly great number of species, occurring chiefly in American waters and being divided nearly equally between the Atlantic and the Pacific coasts. On the Pacific coast, most of the species are concentrated along Mexico and Central America; only one species is common in California, viz., *C. nobilis*, the white sea-bass. While most of the species of Sciaenidae live more or less close to the bottom, the members of *Cynoscion* prefer the pelagic habitat where they travel around mainly in the waters close to the coast, usually within a few miles of land. Some prefer the shelter offered by the large kelp beds, and some are known to enter the mouths of rivers occasionally (e.g., *C. macdonaldi*, the totuava). Most species appear to be school forming.

Two species have been recorded from California, viz., *C. nobilis*, the white sea-bass, and *C. parvipinnis*, the short-fin sea-bass. As is noted above, the former is at present quite common. In regard to the latter, Jordan and Evermann (1898) recorded it to be "common along the coast of Southern California as far north as San Pedro." However, this statement is either incorrect or the distribution of this fish has changed considerably of late years. This seems to follow from the fact that the members of the California State Fisheries Laboratory have searched the fresh fish markets at San Pedro for this species for several years, during which period they were successful in locating a few specimens only on a very few occasions. At least some of these specimens may have been taken in Lower California. It should be remembered that the fish landed at San Pedro is taken along the entire coast of southern California and that a large portion of the catch from

Lower California is sold there. For a further discussion of this question, see the section on the distribution of this species.

Many of the species of the genus are commercially important. All of them are comparatively large and most of them rank high as food fishes. On the eastern coast of the United States, the members of the genus are called weakfishes, due to the fact that their flesh is easily torn; but in many species the flesh is firm.

On the east coast of the United States, the larval development of one of the species of the genus, viz., *C. regalis,* has been studied by Welsh and Breder (1924). The developmental stages figured and described by these authors in all probability agree fairly well with the corresponding ones of the California species. The larval development of our species has so far not been subjected to study.

Key to the Species of Cynoscion in California

1. Pectoral fin more than 0.5 in head. Anal fin, II, 8 or 9_____*C. nobilis*
2. Pectoral fin less than 0.5 in head. Anal fin, II, 10_____*C. parvipinnis*

FIG. 2.

CYNOSCION NOBILIS (AYRES)

White Sea-Bass

Synonymy:

Johnius nobilis Ayres, Proc. Calif. Acad. Sci., 1860, *2*:77; San Francisco.

Otolithus californiensis Steindachner, Ichth. Beitr., 1875, *3*:31; San Diego and Magdalena Bay, Lower California, young specimens.

Cynoscion nobilis. Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880:456.

Atractoscion nobilis. Gill, Proc. Acad. Nat. Sci. Phila., 1862, *14*:17 (*nomen nudum*); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881:48.

Atractoscion nobile. Jordan and Gilbert, Bull. U. S. Nat. Mus., 1882, *16*:579.

Cestreus nobilis. Jordan and Eigenmann, Rept. U. S. Comm. Fish., 1886 (1889):370.

Diagnosis: Lower jaw somewhat projecting. Dorsals closely contiguous. D. X-I, 20-23. A. II, 8 or 9. Pectoral more than 0.5 in head, its tip reaching about to opposite tip of pelvic. Canines small. Back bluish, ventral side nearly white. Young specimens with dusky cross bars.

Description: Body deepest somewhere between anterior and posterior ends of first dorsal; widest somewhere between posterior end of head and middle of first dorsal; greatest depth, 4.5 (4.2-5.2); greatest width, 7.9 (7.2-8.5); proportions about same in small and large specimens (body length, 18-32 cm. and 84-95 cm.). Dorsal and ventral sides may be subequally convex, or either may be slightly more convex than the other. Back not much compressed. Anterodorsal profile flattened or gently concave above eye. Snout rather pointed and long, 3.8 (3.4-4.0) in head. Degree of projection of lower jaw variable, due to symphysis being either rounded or more or less angular. (See Fig. 3**A, B.**) Maxillary extends to posterior edge of pupil or even slightly beyond posterior margin of eye; 2.3 (2.2-2.4) in head. Lower anterior edge of upper lip on level with lower margin of pupil or of eye. Suborbitals, 0.35 (0.30-0.40) of eye. Preopercle either without, or with but slightly developed, crenulation; either all serrae membranous or some have weak ossifications. Eye somewhat larger, relatively, in small specimens; in specimens of 18-32 cm. body length, 1.5 (1.3-1.7) in snout and 6.1 (5.3-6.7) in head; in specimens 84-95 cm. long, 2.5 (2.2-2.8) in snout and 9.1 (8.1-9.8) in head. Snout and chin with minute pores, barely, if at all, visible to naked eye. First dorsal, X; first spine, 0.30 (0.17-0.50) of second, which is 0.5-0.8 of third, which is slightly shorter to slightly longer than fourth; remaining ones decrease in length posteriorly; posterior, 0.16-0.20 of third. Second dorsal, I, 21 (20-23); spine, 0.33-0.50 of first ray, which is slightly longer to slightly shorter than next four or five; remaining rays decrease in length posteriorly; posterior, about 0.4 of longest. Pectorals, I, 16 (14-16); spine, 0.30-0.45 of first ray, which is somewhat shorter than second; third, fourth and fifth longest. Pelvics: spine, 0.4-0.5 of first ray, which is longest and lacks thread-like tip; bases of pelvics separated by about 0.3-0.5 of eye. Anal, II, 9, seldom 8; first spine, 0.25-0.33 of second, which is 0.4-0.6 of first ray, which is longest; remaining rays decrease in length posteriorly; posterior, 0.4-0.5 of first. Caudal gently lunate to subtruncate; with 17, seldom 16, well developed rays. 81 (75-87) pores on lateral line of body; 12 or 13 scales above, 26 (24-27) below lateral line. Second dorsal and anal scaleless.

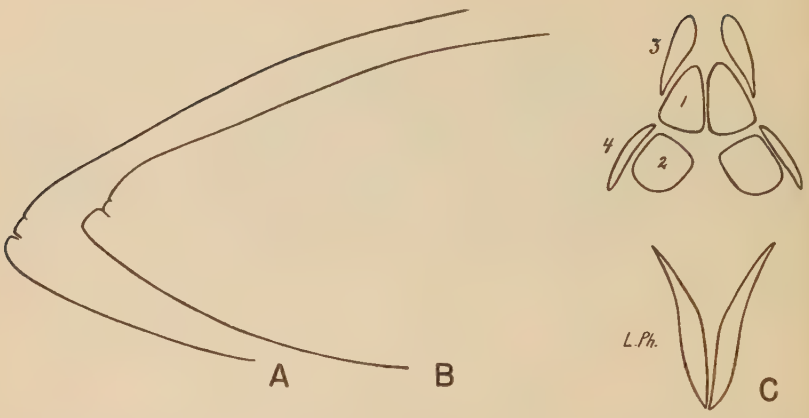

FIG. 3. White sea-bass, *Cynoscion nobilis* (Ayres.) **A** and **B**, left lateral outline of head of two specimens of about 30 cm. body length, showing difference in degree of projection of the lower jaw. **C** shows relative size, shape and position of pharyngeals: "L. Ph.," the lower ones; the upper ones are numbered. Material from southern California, off San Pedro.

Upper jaw: Posterior half of jaw with two irregular rows of teeth which gradually decrease in size posteriorly; anterior half with rather numerous, irregularly arranged teeth, increasing in size anteriorly; a few (2-6) near symphysis usually larger than the others, more or less fang-like. Lower jaw: Posterior half of jaw with single row of teeth, some small, but most of them strikingly larger than corresponding teeth of upper jaw; anterior half with rather numerous, irregularly arranged teeth, on the average smaller than corresponding teeth in upper jaw; inner ones somewhat larger than outer. Gill rakers difficult to count since they are replaced gradually by flat incrustations which tend to merge; usually 8-12 are distinct; longest about 0.5 of eye; each with moderate number of short spines on inside, arranged in single row. Knobs on inside of first arch also difficult to count, due to development of intercalary knobs which tend to merge with original set; all very flat, furnished with numerous fine denticles. Lower pharyngeals 6-8 times longer than wide. (See Fig. 3C.) All pharyngeal teeth pointed, most of them rather small; those on pharyngeal no. 1 and on anterior half of no. 2 decidedly larger than the others; on lower pharyngeals about 4 irregular rows of teeth, of which those of inner row are decidedly the largest. Pyloric caeca, 4 or 5, usually 5, comparatively large. Air bladder with two well developed anterior horns which are about three times longer than wide.

Color bluish, due to fine, dark points dusted over silvery color; when perfectly fresh, with a coppery luster; ventral side whitish, dorsal side more or less dark. Young with 3-6 distinct, dusky crossbars on back, extending down onto sides; change in coloration usually takes place at a body length of 30-35 cm. A dusky blotch at base of inner side of pectoral; inner surfaces of pectorals and pelvics dusky. Gill cavity slightly dusky. Peritoneum nearly white.

The largest species of this family in California. Reaches a body length of more than 4 feet and a weight of more than 80 pounds. Very seldom does one find specimens weighing more than 60 pounds.

Proportions (in standard length):

Length of head	3.7 (3.5-3.9)
Distance from chin to base of pelvics	3.2 (3.1-3.5)
Distance from chin to vent	1.4 (1.4-1.5)
Distance from chin to anterior end of anal	1.4 (1.3-1.4)
Distance from chin to anterior end of first dorsal	3.1 (2.9-3.5)
Depth at posterior end of head	5.0 (4.7-5.6)
Depth at vent	5.9 (5.3-6.7)
Depth of caudal peduncle	13.7 (11.8-17.2)
Length of first dorsal	4.6 (4.3-4.9)
Length of second dorsal	3.3 (3.0-3.5)
Length of pectorals	5.9 (5.2-6.5)
Length of pelvics	7.8 (6.9-9.9)
Length of anal	10.6 (9.5-12.7)
Length of caudal	6.2 (5.4-8.1)
Greatest height of first dorsal	9.5 (7.8-11.4)
Greatest height of second dorsal	10.2 (8.9-11.9)
Greatest height of anal	10.1 (9.1-11.2)

Measurements were made of five specimens of a body length of 84-95 cm. and of 15 specimens, 18-32 cm. long. All specimens were taken in southern California.

General Range: West coast of North America, from Victoria (British Columbia) south to the Gulf of California. Only one specimen has been recorded north of California, viz., one taken by Mr. Ashdown Green (Jordan and Evermann, 1898), and this was undoubtedly a straggler which had strayed far away from its original home.

Occurrence in California: The white sea-bass is common in southern California. North of Point Conception it becomes more and more scarce, and north of Marin County (near San Francisco) only small schools or stragglers occur at present. In other words, just as the queenfish, this species appears to be moderately stenothermal, with a preference for the warmer waters which occur south of Point Conception. In order to illustrate the differential distribution of the white sea-bass along the California coast, table 2 is presented. The arrangement of the counties is from north to south. San Luis Obispo and Santa Barbara may be considered the most northerly counties of southern California.

TABLE 2

Distribution of White Sea-Bass Catches by Counties 1923-1927

Percentage of State Catch	*County*
0.02	Del Norte
	Humboldt
	Mendocino
	Sonoma
1.6	Marin
0.0	Alameda
	Contra Costa
2.6	San Francisco
4.2	Santa Cruz
2.4	Monterey
8.5	San Luis Obispo
	Santa Barbara
	Ventura
64.6	Los Angeles
1.0	Orange
15.1	San Diego

In other words, during these years not less than 89.2 per cent of the total catch was landed in southern California. The great predominance of Los Angeles County over Orange and San Diego counties was not caused by the white sea-bass becoming scarcer toward the Mexican border. It was simply due to business reasons, Los Angeles County being much more densely populated than the other two counties. After 1927, the proportion of white sea-bass in the waters south of Point Conception became even more pronounced, as will be seen in table 3.

TABLE 3

White Sea-Bass Catches in Central and Northern California

	Pounds	*Percentage of total California catch*
1928	61,809	7.5
1929	108,681	11.4
1930	94,227	7.6
1931	61,303	5.8
1932	34,744	5.2
1933	6,820	0.8
1934	2,769	0.6
1935	1,557	0.2
1936	11,523	2.0
1937	39,874	15.1

For all practical purposes, Marin County forms the northernmost limit of this species. Between 1928 and 1936, the white sea-bass was taken north of this county only in two years, viz., 1929 and 1930. In 1929, 44 pounds were landed in Mendocino County; and in 1930, 139

pounds were recorded from Del Norte County and 77 pounds from Mendocino County.

Especially noteworthy in table 3 is the consistent decline of white sea-bass between 1929 and 1935, inclusive. In order to give to this decline its proper emphasis, it should be noted in this connection that in 1889, according to the records of the United States Bureau of Fisheries, not less than 325,000 pounds of the California total of 455,347 pounds was landed in San Francisco.

These data undoubtedly demonstrate a remarkable decline in the frequency of the white sea-bass in the northern part of its distributional area. It is true that the center of human population in California has shifted in the last fifty years from the region around San Francisco to Los Angeles County. However, while this shift accounts for the increase in the white sea-bass catch in southern California, it does, of course, in no manner relate to the decrease in the catch of central California, since the human population in this area has increased consistently during the last fifty years, although not by any means as fast as that of Los Angeles County. Furthermore, the decline can not be attributed to a decrease in the fishing effort relative to this species in central California. The species is as popular as ever as a food fish, a statement well borne out by the fact that large quantities of this fish are transported from southern California to the region around San Francisco. Additional facts bearing on this aspect of the problem are contained in a letter which I received from G. H. Clark of the California Division of Fish and Game. Mr. Clark writes as follows: "An old time bass fisherman fished (in 1936) for three days in the Bolinas Bay region with gill nets and while he caught several fish, he claims that there is no use in fishing for the white sea-bass are not there any more. The same occurred in Tomales Bay where a fisherman worked for three days without catching a single fish." The same letter contained the information that within San Francisco Bay, only one or two specimens of this species were taken each week in the salmon catch in 1936.

In regard to the cause or causes of the phenomenon of disappearance, it is, of course, necessary to proceed with the utmost caution. However, it may be safe to state that in all probability this deplorable result was brought forth by a combination of at least two independent factors, viz., changes in the hydrographic conditions and overfishing. Of the possible explanations for the shift in the fishery, the one given below seems most plausible to the writer.

That hydrographic changes must be taken into account is strongly suggested by the circumstance that no commensurate decline in the white sea-bass fishery took place in southern California in spite of the fact that the fishing operations for this species were never so intensive in central California as they were in southern California during the last two to three decades. It should be noted that the sea-bass fishery of central California had declined before the modern, very effective purse seine method had become highly developed in California. It is true that the white sea-bass has suffered in southern California through too intensive exploitation, but this exploitation notwithstanding, there is at present quite a large stock of the species in these waters.

In other words, the fact that less than fifty years ago the white sea-bass fishery had its center in the waters off San Francisco, whereas at present this center is located south of Point Conception is mainly due to a dislocation of the general distribution of the species; and this dislocation was in all probability associated with changes in the environmental conditions. If this assumption be correct, then the northerly representatives of the white sea-bass must be classified as "relics," i.e., as the survivors of a once abundant population. The expression, "a dislocation of the general distribution of the species," should not be interpreted to signify that adverse environmental conditions caused a general exodus of the species. Rather, these conditions caused the more or less pronounced failure of the reproductive activities of the species in the northerly portions of the distributional area, and thus secondarily the destruction of a large portion of the species. It is a well known fact that most organisms are highly vulnerable during the early developmental stages. In this connection it is of the greatest interest to note that the white sea-bass spawns during the summer, a season which in central California is characterized by striking hydrographic fluctuations. During this period the hydrography is dominated by the upwelling phenomenon, i.e., by the upward movement of cold water from a depth of about 200 to 300 meters. The degree to which this cold water affects the superficial strata is subjected to decided variations from one year to the next. In other words, the fact that this species spawns during the summer in central California exposes it to a pronounced hazard.

A general characteristic of the relics of warm water species is that they prefer the warmest parts of their general habitat, especially during the period of reproduction. From this viewpoint it is of interest to note that the white sea-bass in its present depleted condition appears to have been eliminated nearly everywhere except in and around Soquel Cove, which is the warmest part of Monterey Bay in the summer, and in and near Tomales Bay (some distance north of San Francisco), where the water in the summer is warmer than in the neighboring regions. (It also occurs in Bolinas Bay, near San Francisco, but the hydrographic conditions in this region are not sufficiently known to be adduced in this connection.) Whether this peculiarity of the present distribution of the white sea-bass in central California supports the interpretation of the northern outposts of this species as relics can not be definitely asserted at present.

It is unfortunately impossible to carry through a correlation between the changes in the distribution of the white sea-bass and the variations in the hydrographic conditions along the central and northern California coast. During the critical period of the shift, from 1889 to 1915, no serial hydrographic observations were made in this region.

In other words, there is at present no possibility to *prove* that the depletion of the abundant local stock of this species in central California was in any manner connected with changes in the environment.

The following is the only available information bearing on the problem. Before 1920, there was a flourishing gill net fishery for white sea-bass in the southern portion of Monterey Bay. Most of these fishing operations were carried on close to the shore just to the north and northwest of the little cove where Monterey is located. For a few years

before and after 1920, this fishery was declining; and about 1924, as far as I have been able to ascertain from local sources of information, it had ceased, at least for all practical purposes. In 1923 only 690 pounds of this species was landed in Monterey County.

The opinion that the white sea-bass ceased to inhabit the southern portion of Monterey Bay in a regular manner, I have gathered, as stated above, from local sources of information. My informants, practical fishermen, were quite positive in their opinion. However, the published fisheries records apparently do not support this idea. According to the statistics of the California Division of Fish and Game, the total catch of white sea-bass landed in Monterey County was not less than 125,685 pounds in 1926. In 1929, this catch amounted to 5997 pounds and from that time it declined by and large until 1935 when it was only 281 pounds. Following this low year, the catch seemed to exhibit signs of recovery; in 1936, the Monterey landing was 460 pounds while the Santa Cruz landing was 6621 pounds; and in 1937 the situation was even more favorable with 3682 pounds landed at Monterey and 24,558 pounds at Santa Cruz.

These data, apparently contradictory to the statement of disappearance made above, must, of course, be explained. As far as I can judge, the explanation is twofold. The explanation of the record catch in 1926 probably is as follows. In that year we had, according to Hubbs and Schultz (1929), unusually high water temperatures along the coast of central and northern California and along the coast of Oregon. As illustrated by these authors, this phenomenon was associated with abnormal northerly migrations of a number of different species of fish. The white sea-bass is known to be migratory to a limited extent. Thus it appears to be a fair possibility that the abnormally large catch of this species in Monterey County in 1926 was associated with, if not induced by, the abnormally high temperatures along a large section of the coast. In other words, it consisted at least largely of an immigrant population rather than of a native stock. In regard to the landings in Monterey County in the years following 1926, it should be noted that the Monterey fishermen have extended their fishing operations farther and farther to the north; and that the white sea-bass is known to migrate, normally, to a limited extent. Thus these landings do not, of necessity, contradict the opinion held by the fishermen that the local stock of white sea-bass in the southern portion of Monterey Bay has become extinct or at least nearly so.

Concerning the hydrographic conditions in Monterey Bay which may have had an effect on this development of the white sea-bass fishery, the following information about the temperatures must suffice. In the southern part of Monterey Bay, records of the surface temperatures have been taken daily ever since 1919. It is of interest to note that from 1919 to 1924 the average annual temperature declined nearly consistently and that in 1924 the lowest annual average temperature, as well as the lowest summer temperature for the period from 1919 to 1934, was recorded. (It should be recalled in this connection that the white sea-bass spawns in the summer and that the species is most vulnerable during the early developmental stages.) Following 1924, the average annual temperature rose consistently until 1931, inclusive, but

apparently the damage caused by the adverse years which culminated with 1924 had been too severe to allow the stock to recover rapidly. The recovery was made particularly difficult due to the intensive fishing activity which was carried on meanwhile both in the northern and southern portions of the bay. (Compare Skogsberg, 1936, pp. 80 and 143.) Whether the apparent increase in the white sea-bass fishery in central California in 1936 and 1937 was caused by northerly migration of southerly schools or by a partial recovery of the local stock can not be stated as yet. (Whether parts of the schools, which are supposed to migrate north, remain in the north and thus increase the central California local stock is, of course, unknown.)

Other hydrographic factors may, of course, also have been active in bringing forth the phenomenon of disappearance from the southerly portion of Monterey Bay, but of these we know too little to allow us to bring them into the discussion. Studies on fisheries ecological problems have taught us, however, that of the various changeable environmental factors, temperature conditions are the most important.

As stated above, the problem can not be settled at present, due to lack of information. However, even so it is well worthy of our attention, especially since the histories of other marine California fish species exhibit the same peculiarities. (See the section, "Distribution" under *Cynoscion parvipinnis*.)

The white sea-bass is decidedly seasonal in its occurrence along the coast of southern California. Only few and small schools are seen during the winter, from November to February, inclusive. In March, larger schools begin to appear between Los Coronados Islands and Point San Juan. These schools increase in number and size as the season progresses, and at the same time the fish are found farther to the north. Whether this phenomenon is due to a coastwise migration in a northerly direction, and repeated each year, as the fishermen assume, is still not known with any degree of certainty. It may be caused by the fish retiring into deeper waters, where they become less available to commercial exploitation. In support of the latter explanation, it may be mentioned that during the time of a successful gill net fishery for this species in the southern part of Monterey Bay, the fishing began in the middle of the summer (July). At that time and until the middle of October, the gill nets were placed at or near the surface. From the middle of October until December, inclusive, the fish retired into deeper waters and the nets were placed along the bottom. Following December, until the middle of the next summer, the fish could not be located by the fishermen. Did they continue the movement initiated in October into still deeper waters where they were beyond the reach of the fishermen? On the other hand, a fact worthy of consideration in this connection is the difference in the fishing seasons between the southern and northern districts; by and large, it may be said that the seasons were later in the north. Such seasonal differences have been proven in other fisheries to be associated with a coastwise migration. However, the very limited nature of this seasonal difference and the very pronounced difference in the frequency of the white sea-bass in the south and in the north strongly militate against such an assumption.

In order to illustrate the seasonality of the white sea-bass in southern California, table 4, compiled from records of the California Division of Fish and Game, is presented.

TABLE 4

Monthly Landings of Local White Sea-Bass in Los Angeles County, 1923-1927, Expressed in Percentage of Average Annual Catch for County

January	0.4	July	16.6
February	1.1	August	22.8
March	2.6	September	7.9
April	6.4	October	2.2
May	22.2	November	1.0
June	16.3	December	0.5

From this table it will be seen that out of the annual total catch for Los Angeles County, not less than 77.9 per cent was landed in the four summer months, May, June, July and August. The fact that the yield decreased in June and July was not due to a decline in the natural supply but to the circumstance that a large number of fishermen dropped the white sea-bass fishing in order to take up the more profitable tuna fishery.

It is of interest to note in this connection that during the four winter months, from November to the end of February, the white sea-bass fishery is comparatively good in the waters of Lower California.

White sea-bass frequently occur in or near the large kelp beds which fringe the beaches of southern California. Here they are fairly well protected and difficult to catch except with gill nets which are placed in among the kelp. However, they are also found several miles off shore swimming around in schools of varying sizes at or near the surface. During some months of the year they apparently have a tendency to live more or less close to the bottom in somewhat deeper waters.

Food: The species is very voracious and lives mainly on other fish. In a specimen with a body length of 31.5 cm. (about 12 inches), not less than eight anchovies were found, the largest of which was 7 cm. long.

Breeding: In southern California, spawning takes place from April until August, May and June apparently being the period of most intensive spawning. (See also Skogsberg, 1925, p. 53.) Nothing is known in regard to the early life-history, but in all probability it is more or less the same as that of the weakfish (*Cynoscion regalis*) of the east coast of North America (Welsh and Breder, 1924). In other words, spawning is confined to the immediate vicinity of the coast and the eggs are buoyant. It is of interest to note that on one occasion, during an unusual freshet at San Diego in 1889, large numbers of ripe white sea-bass ascended the temporary fresh-water streams. This is especially noteworthy since *Cynoscion regalis* has been found to spawn in the brackish waters near the mouths of small streams. This tendency may still be present in the California species, even though there is usually no possibility for its expression due to the nearly complete absence of streams in southern California during the summer months.

Small white sea-bass, with a body length of less than 30 cm. (about 12 inches) were seen but seldom in the fresh fish markets of southern

California before these sizes were protected by law. However, these small sizes, 6-12 inches, are not infrequently taken by fishermen seining for anchovies in about 30-40 feet of water and by sportsmen from the piers, indicative that the young stages live in close vicinity to the beach, just as do some of the large ones. These stages have been taken also in Newport Bay. (On account of their coloration and general appearance, white sea-bass about 30 cm. long are called "sea trout" in common parlance, a misleading name which should be avoided.)

Clark (1930.2) has undertaken a preliminary investigation of the size of the white sea-bass at the time of maturity. The main results of this work were as follows: "No males smaller than 50 centimeters or about 20 inches were found maturing. The smallest female with ripening eggs was 60 centimeters, 24 inches, in length. About 50 per cent of the males were maturing at this length, while 50 per cent of the females were not maturing at less than 70 centimeters, 28 inches." In all probability, all white sea-bass are mature at 80 cm. body length. Clark concluded that the large males may mature in their second year, while no females mature until they are three years old. In the same report, Clark also established the weight-length relationship. Fish averaging 60 cm. in length weighed about 4.5 pounds, while the 70 cm. and the 80 cm. long fish averaged 5 and 11 pounds, respectively.

Commercial Importance and Sport Fishing: The white sea-bass is by far the most valuable food fish among the members of the croaker family living in California. If we consider all the species of local fish landed in this State in the course of 1935, the white sea-bass ranked in order of the weight of the total catch as number twenty among the more than fifty classified items included in the statistics published by the California Division of Fish and Game. It should be remembered that several of these items represented two or more species lumped together, a fact which, of course, rendered the position of the white sea-bass even more favorable. Furthermore, if we consider only the species which are sold in the fresh fish markets, that is, if we omit those which are sold exclusively, or nearly so, in the canneries, then the position of the white sea-bass was number ten in the year mentioned above. Indeed, the species had an even more favorable position if we take into account the market value, since it is one of the most highly esteemed and therefore one of the most expensive of all the fish available in the State. It should also be noticed that a few years ago the commercial significance of the species was much greater, as will be understood from figure 4; indeed, about 1920 it was approximately twice as prominent. The kingfish is the only other California croaker which is commercial, if we exclude the slight admixture of queenfish to the kingfish catch, and its role is extremely subordinate. (Other croakers were once commercially important and could possibly be so now, if it were not for legal restrictions.)

The flesh of the white sea-bass is firm and rich, and the great demand for this fish in the markets causes its price to be relatively high. So far there has been no demand for the species in the canning industry.

Table 5 represents, as far as statistics are available, the development of the white sea-bass fishery in California, in local and Mexican

waters. The data from 1889 to 1915, inclusive, are from the United States Bureau of Fisheries (Skogsberg, 1925, p. 50), the remaining ones are based on the revised records of the California Division of Fish and Game. It should be noticed that during the first few years of the totuava and corbina fisheries in Mexico, an unknown percentage of these species was classified and recorded as white sea-bass (see above, pp. 9-10). Disregarding this discrepancy, the data of the California Division of Fish and Game can be regarded as very reliable. On the other hand, the information dating before 1916 must be considered as rather rough estimates.

TABLE 5

Annual Amounts, in Pounds, of White Sea-Bass, Landed in California

Year	Local origin	Mexican origin	California and Mexico
1889			455,347
1890			325,662
1891			393,559
1892			257,712
1895			669,780
1899			938,156
1904			1,056,534
1908			1,337,000
1915			1,227,345
1916	477,091	321,024	798,115
1917	869,187	30,810	899,997
1918	1,458,667	154,853	1,613,520
1919	2,380,713	74,654	2,455,367
1920	2,375,646	252,462	2,628,108
1921	2,069,514	500,075	2,569,589
1922	2,195,831	736,220	2,932,051
1923	1,781,970	591,877	2,373,847
1924	938,660	550,829	1,489,489
1925	890,437	994,672	1,885,109
1926	1,477,789	738,613	2,216,402
1927	806,559	1,466,848	2,273,407
1928	824,879	475,335	1,300,214
1929	955,556	606,676	1,562,232
1930	1,239,285	387,137	1,626,422
1931	1,057,714	341,251	1,398,965
1932	667,363	137,433	804,796
1933	824,539	334,950	1,159,489
1934	468,299	382,898	851,197
1935	648,900	417,519	1,066,419
1936	564,956	242 823	807,779
1937	263,195	336,224	599,419

We do not know how much, if any, white sea-bass was taken in Mexican waters and landed in California before 1916. However, in all probability nearly all the fish recorded for these years in table 5 was of local origin, except in 1915. This statement is based on the fact that hardly any large boats were used in the fishing operations carried out from southern California before 1915.

Figure 4 represents graphically the data included in table 5. It shows that the white sea-bass industry increased very substantially between 1889 and 1915. As we have seen above, in the beginning the fishing operations were centered around San Francisco. Later on the fishery shifted to the south, but there is no information as to when this shift took place beyond that in 1916 southern California was decidedly dominating. The decrease in landings from 1915 to 1916 was probably apparent only and due to the change in the statistical methods. If this assumption be true, it demonstrates that the early statistics should

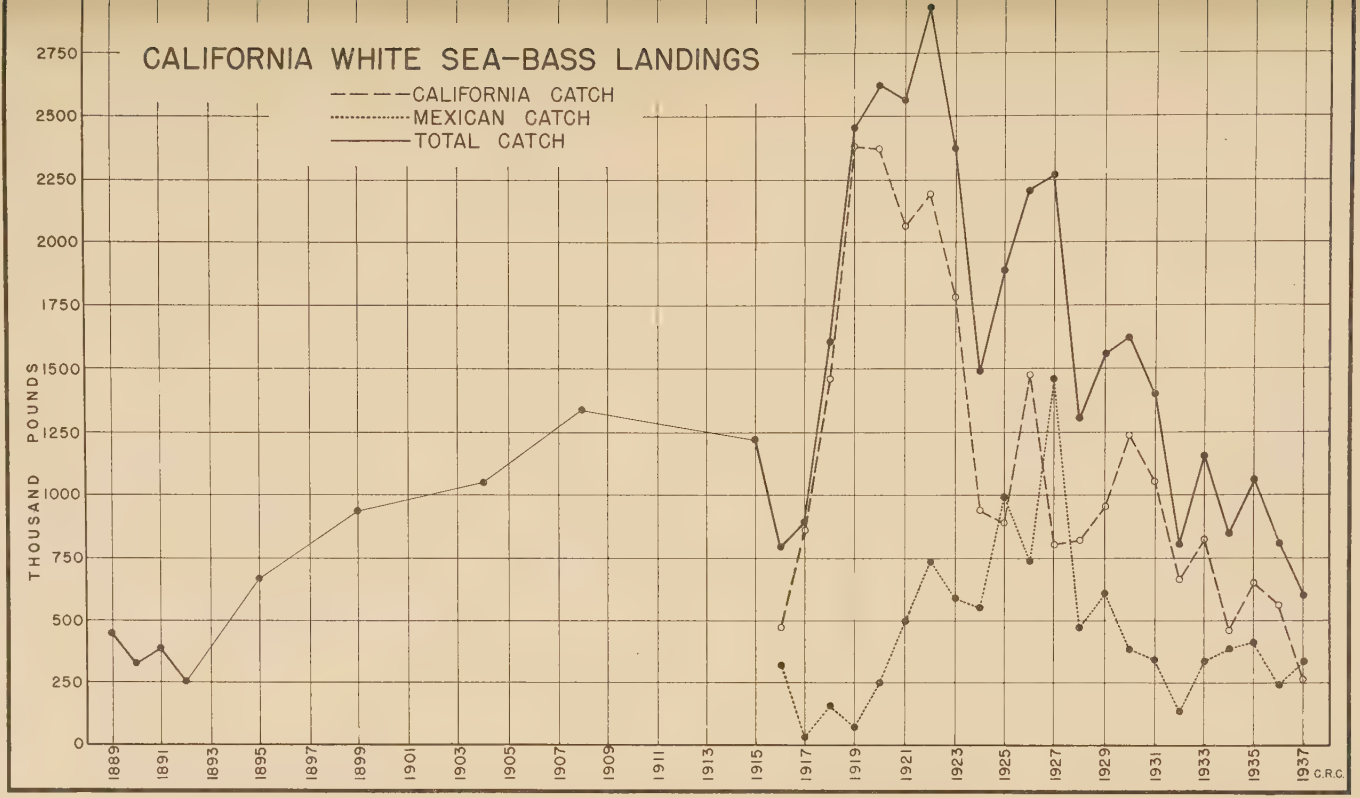

FIG. 4. Commercial landings of white sea-bass in California from Mexican and California waters, 1889 to 1937, inclusive. Data for 1889 to 1915, inclusive, from U. S. Bureau of Fisheries; data for 1916 to 1937, inclusive, from California Division of Fish and Game.

be considered as somewhat uncertain. Between 1916 and 1920, a most spectacular development occurred in the local fishery, the enormous increase in the landings undoubtedly being due first to improvements in fishing methods, and second to the increase in the demand for sea food brought forth by the World War. The extraordinarily high totals of 1919 and 1920 have never been equalled since. Between 1921 and 1925, inclusive, the decline in this fishery was nearly as spectacular as was the growth during the preceding years; in 1925, the total was only slightly greater than one-third of 1919 and 1920. The succeeding development of the white sea-bass fishery in California waters has been very irregular, but the annual totals have never been much higher than about one-half of those in the two record years just mentioned. In the last few years, the total landings have fluctuated roughly between 500,000 and 800,000 pounds; in other words, a fairly balanced condition appears to have prevailed of late. The amounts of this fish taken in Mexican waters increased rapidly between 1917 and 1927, even though some irregularities occurred in the growth of the landings. From the end of the mentioned period until the present time, the Mexican operations for this species have declined in a very striking manner. However, even so, Mexican waters have remained a most important source of the species. The decrease was probably due to a large extent to the export duty on fish which the Mexican government had established.

The interpretation of these data is fraught with difficulties. Many factors are involved, both sociological and biological. For instance, the types of the fishing gear and boats, the demand in the markets which is influenced both by personal preference and the availability of other fish foods, the general economic situation, the amount of natural supply available, etc., all play their roles. It may be safe to state, however, that the general decline from 1920 on has been caused to a large extent by a decided decrease in the natural supply. Two main factors substantiate this conclusion. The first of these is the heavy fishing operations for the species in Mexican waters. In general, a decided increase in the fishing area is a strong indication that the local supply is decreasing if at the same time the local yield shows a marked decrease. Second, and still more important, according to the investigations of Whitehead (1930.1), there was between 1918 and 1928 a decided decline in the average boat catch per month and in the average boat catch per trip in regard to the gill net operations. Whitehead states that we can safely assume that the availability of the white sea-bass to the fishermen decreased each year during the noted decade, and that, unless such a decrease in the availability was associated with a change in the habitat of the fish, the decrease in the yield must be interpreted as a sign of the depletion of the natural supply. Indeed, nearly everything points in the direction that the species is submitted to altogether too heavy a strain.

In spite of the fact that the white sea-bass has not as yet been submitted to a detailed scientific study, the California State authorities have been fully aware for several years that the species was being overfished. In order to prevent disastrous results, protective laws were enacted. These legal regulations were as follows:

1931-1933:

Closed season on the taking of white sea-bass in May and June with exception noted below. (It should be noted that these two months represent the period of heaviest spawning.)

Size limit of 28 inches, measured from tip of the lower jaw to end of longest lobe of the tail, with provision that five sea-bass irrespective of size may be taken by hook and line at any time and held in possession, but are not to be bought or sold or offered for sale.

Use of nets other than bait nets prohibited in district 19A (Santa Monica Bay, Rocky Point to Malibu Point).

Use of nets prohibited within four mile radius of San Juan Point in Orange County.

1933-1935:

White sea-bass may be taken with hook and line at any time. Between May 1 and June 30, the bag limit on this species taken with hook and line is five per day. Effective until October 25, 1933.

After October 25, 1933, a prohibition to sell the species between May 1 and June 30 was added to the above regulation.

No white sea-bass less than 28 inches in length may be taken, except that not more than five white sea-bass, regardless of size, may be taken per day with hook and line at any time.

No white sea-bass less than 28 inches in length may be sold or purchased. San Juan Point and Santa Monica Bay still closed to net fishing.

1935-1937:

White sea-bass may be taken with hook and line at any time.

More than five white sea-bass of less than 28 inches in length may not be taken or possessed at any time.

No white sea-bass less than 28 inches in length may be sold or purchased. It is unlawful between May 1 and August 31 for any person to have in possession on any boat, barge or vessel, more than 500 pounds of white sea-bass. During the same period, not more than 2500 pounds of white sea-bass may be possessed on any boat, barge or vessel, at any time.

It is unlawful to use any net to take white sea-bass between May 1 and August 31. San Juan Point closed area extended to include all Orange County waters within two miles of shore. (This law later declared unconstitutional because of a technicality.) Santa Monica Bay still closed to net fishing.

1937-1939:

Laws in effect in 1936 not changed, except that angling license is now required for catching sea-bass for sport.

In addition, all or part of the waters surrounding Santa Catalina Island have been closed to net fishing since 1913.

As will be seen from this summary, the restrictions have become increasingly strict as time passed. The main features of the restrictions aim to protect the species during the spawning period and to secure a chance for all specimens to spawn at least a couple of times before they are caught. However, it may be doubtful if even the present legislative measures are sufficient to safeguard a *maximum* production of the species, even though they have permitted the maintenance of a fairly good yearly catch. The enormous increase in sport fishing must also be given serious consideration.

Commercially, the white sea-bass is caught mainly with nets, such as gill nets, round haul nets, lamparas, and purse seines. Some commercial fishing with hook and line, with live bait, is also done. The gill nets are usually set just outside or within the large kelp beds that fringe the coast of southern California. The round haul and purse seine fishermen operate in open waters, generally within a couple of miles of the shore. Nearly all their fishing is done at night, when the schools are readily located by the phosphorescence in the water. As is well known, this phenomenon is caused by microscopic animals and plants which emit light when they are mechanically stimulated by the movements of the fish. When left undisturbed, the schools of the white sea-bass frequently remain still for long periods at night. However, they can usually be located by the occasional sparkling due to a few restless individuals. When disturbed by the approach of the fishing boat, the entire school usually makes a sudden, violent move, thus causing the water to glow with an intense phosphorescence; then it stops

suddenly, and once more darkness prevails. This peculiar behavior is very characteristic of the species. The fishermen say, "If the light (phosphorescence) is very bright and white and the school makes a mad dash and then stops all of a sudden, then it is white sea-bass." After the school has been thus located, the net is placed around the spot where the light was last seen; and, if luck is good, it will soon be filled with a luminescence of remarkable beauty caused by the excited dashing back and forth of the fish, stirring up the water laden with phosphorescent microörganisms, and by the movement of the net, every mesh of which can be seen in a glowing outline. Not seldom the school tends to split up into smaller units at the approach of the boat.

Most of the Mexican white sea-bass is caught by purse seiners, and during the winter months most of the supply of this fish is of Mexican origin. In the summer, the local fishery predominates and this is carried out to a large extent with gill nets (Skogsberg, 1925, p. 59).

Until a comparatively few years ago, white sea-bass were of subordinate importance to the sport fishermen due to the fact that they appeared to be reluctant to take the bait. Regarding this condition, J. H. Wales wrote as follows: "Few white sea-bass are taken from the piers of southern California. The best method is to keep a small, live mackerel on the hook near the bottom. The young are very gamy. Most of the specimens caught in 10-20 feet of water are about 1-1½ feet long, but occasionally a 20-pounder is landed." This condition seems to have prevailed until the last few years of the last decade. Due to the known gamy nature of the species, experiments were carried out in those years with different kinds of spoon hooks, but with negative results according to N. B. Scofield of the California Division of Fish and Game.

At present the situation is entirely changed. Nowadays the sport catch of white sea-bass is of considerable magnitude. This statement is based on statistics collected by the California Division of Fish and Game. The gathering of preliminary data was begun several years ago and in 1936 the first figures were available, showing a total sport catch of 133,000 pounds. The 1937 catch amounted to 118,000 pounds. It should be noted that this value shows only the total amount taken from sport fishing boats and barges; in other words, it does not include the catches from the piers, the shore or from private boats, for which no records are available. However, even so, it is probably very close to the actual value, since sport fishing for this species is but slightly successful except under the very special conditions available to the men fishing from boats and barges. It may be of interest to note that the enthusiasm for this sport has become so great that some of the sea-bass fishermen have organized themselves into a special club for the promotion of their mutual interests. Nowadays, the white sea-bass ranks with the yellowtail as the most attractive medium-sized sport fish in southern California, next to the tunas.

The fishing grounds extend from Point Dume on the north side of Santa Monica Bay to Point Loma at San Diego along the mainland; and excellent places are also found around Santa Catalina Island and Los Coronados Islands. The season extends from April to October. The catches are not uniformly distributed throughout the season but fluctuate widely. Spurts of success last from a few days to a couple

of weeks, and these spurts occur at irregular intervals and at scattered localities. The noted season represents the time during which the sportsmen are particularly active in this fishery. Occasional specimens are caught throughout the remainder of the year.

Due to the present decided limitation of the natural supply, the fishing parties do not as a rule set out for the exclusive purpose of catching white sea-bass but they go to the places which are mostly frequented by this species, i.e., to places in or near the kelp beds. Usually they satisfy themselves with other species, most of them attractive to the sportsmen, such as barracuda, kelp bass, yellowtail, etc. However, when a school of white sea-bass is located, all efforts are concentrated on this fish; all other species apparently lose their attraction. The method of fishing, which has been worked out during the last few years, is characterized by a very heavy "chumming," that is, by the liberation of large quantities of small live fish, such as small sardine or anchovy. The chumming is indeed heavier than in the case of the other fisheries in which this method is applied. By the chumming, the white sea-bass school is lured up toward the surface and in the excitement caused by their intensive feeding, the bass begin to catch without fear or caution the live fish with which the hooks are baited. However, since their mouths are readily torn, many bass that have been hooked escape being caught. Most of the white sea-bass taken in this manner are fairly large, about 10 to 20 pounds, but specimens weighing as much as 60 pounds have been recorded. A party of sportsmen frequently bring home more than a thousand pounds; and Richard S. Croker observed on one occasion in 1935 a sport load from Los Coronados Islands of about 285 sea-bass averaging not less than 25 pounds each. Another record catch was made by 19 anglers on a sport fishing boat when they caught 379 white sea-bass at Catalina Island on September 11, 1938. These were small ones, as the total weight was about 3500 pounds.

The following interesting description of this sport occurs in the information which Mr. Croker sent me: "Two of the most exciting events of the sport fishing season in southern California are the brief runs of white sea-bass at Newport Beach and Avalon, Santa Catalina Island. During the dark of the moon in May, the sea-bass strike into the pier at Newport on nightly raids on the large sardines hanging around the pier. On those nights, from dusk until about 3 a.m., the pier is literally thronged with fishermen. If there is any angler you want to locate, you will find him at Newport on some balmy May night. Large sardines, caught by snagging, are used as bait. Live ones are best but dead ones are fair. The nightly catch ranges from nothing to perhaps twenty, so most of the fishermen are not successful. Very seldom is a fish less than 20 pounds taken, nearly all running from 40 to 50 pounds. At Avalon the best sea-bass fishing is at night during the full moon in June and July. There skiffs are used, and the bait is trolled astern. Large sardines, small flying fish, or fillets of flying fish, are used as bait. The bass are of the same size as at Newport. I believe that a 60-pounder was caught at Avalon in 1936. At both places, I have seen hard-boiled commercial fishermen and charter boat skippers, who have worked hard at fishing all day, patiently angling half the night with sporting tackle for sea-bass."

FIG. 5.

CYNOSCION PARVIPINNIS AYRES

Short-fin Sea-Bass

Synonymy:

Cynoscion parvipinnis Ayres, Proc. Cal. Acad. Sci., 1858-1862 (read Dec. 1, 1861; pub. Sept. 1862), 2:156, fig. 48; coast of Lower California.

Otolithus magdalenae Steindachner, Ichth. Beitr., 1875, 3:34; Magdalena Bay, Lower California.

Cynoscion parvipinne. Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 3:456.

Cestreus parvipinnis. Jordan and Eigenmann, Rept. U. S. Comm. Fish., 1886 (1889):369.

Eriscion parvipinnis. Jordan, Evermann and Clark, Rept. U. S. Comm. Fish., 1928 (1930), (2):356.

Diagnosis: Lower jaw somewhat projecting. Dorsals contiguous. D. X-I, 22 or 23. A. II, 10. Pectoral less than 0.5 in head, its tip not nearly reaching as far back as tip of pelvic. 1 or 2 large canines. Steel blue above, silvery below.

Description: Body nearly of same shape as in white sea-bass; greatest depth, 3.9-4.3; greatest width, 7.3-7.7. Anterodorsal profile evenly and slightly convex. Snout rather long and pointed, 3.6-4.0 in head. Maxillary extends somewhat beyond pupil, 2.2-2.3 in head. Lower anterior edge of premaxillary on level with lower margin of pupil or of eye. Suborbitals, 0.3-0.4 of eye. Preopercle as in white sea-bass. Eye somewhat larger, relatively, in small specimens; in a specimen of 19 cm. body length, 1.5 in snout and 5.2 in head; in a specimen 30 cm. long, 1.8 in snout and 6.6 in head. First dorsal, X; first spine, 0.2-0.4 of second, which is 0.7-0.9 of third, which is longest; remaining ones decrease in length posteriorly; posterior about 0.15-0.20 of third. Second dorsal, I, 22 or 23; relative lengths of spine and rays about same as in white sea-bass. Pectorals, I, 15, as in white sea-bass. Pelvics, as in white sea-bass. Anal, II, 10; first spine, 0.3-0.4 of second, which is 0.4-0.5 of first ray, which is longest; remaining rays decrease in length posteriorly; posterior 0.4-0.5 of first ray. Caudal somewhat lunate in adults; in young, middle rays somewhat produced; with 17 well developed rays. 66-75 pores on lateral line of body; 13 scales above, 24 below lateral line. Soft dorsal and anal scaleless.

Usually only a single large canine in upper jaw. Gill rakers shortish 3 or 4 + 7 or 8; longest, 0.4-0.5 of eye. Teeth of lower pharyngeals small, cardiform; inner ones somewhat enlarged.

Color clear steel blue above, without stripes or spots but with numerous small dark points; silvery below; a narrow dusky shade along sides below lateral line; axil dusky; lower fins yellowish-white with dusky shading; upper fins and tail fin dark; second dorsal dark edged.

Probably not exceeding a couple of feet in length.

Proportions (in standard length):

Length of head	3.0-3.5
Distance from chin to base of pelvics	2.9-3.3
Distance from chin to vent	1.4-1.5
Distance from chin to anterior end of anal	1.3-1.4
Distance from chin to anterior end of first dorsal	2.7-3.0
Depth at posterior end of head	4.5-5.0
Depth at vent	4.7-5.0
Depth of peduncle	10.0-11.2
Length of first dorsal	4.8-5.0
Length of second dorsal	3.2-3.7
Length of pectorals	6.8-7.2
Length of pelvics	6.2-6.4
Length of anal	9.4-9.6
Length of caudal	4.7-5.4
Greatest height of first dorsal	7.1-8.1
Greatest height of second dorsal	7.1-8.0
Greatest height of anal	7.3-8.6

The description is based on previous descriptions and published figure and on two specimens in the collection of Stanford University, one of which was taken at San Diego, the other in Lower California.

Distribution: At present the short-fin sea-bass occurs along the west coast of Lower California and in the Gulf of California. Its southern distributional boundary is not known with certainty. In regard to the northerly outposts, it may be noted that Starks and Morris (1907) recorded one specimen from San Diego, California; however, this specimen was probably seen in the fish markets and thus was not of necessity taken to the north of the international boundary line.

The most interesting feature of the distribution of the species is that Jordan and Evermann (1898) reported this form to have been found as far to the north as Santa Barbara, California, and that it was "common along the coasts of southern California as far north as San Pedro." As has been noted above, under the general treatment of the genus, the last statement does not apply at the present time. At least normally, the species is not any longer a member of the fish fauna of this State. Considering the fact that the present distribution of this fish in California must be regarded as reasonably well established, because of the knowledge accumulated through the intensive fishing operations in the southern part of this State, our first reaction to the information given by Jordan and Evermann is apt to be that it must be erroneous. However, this conclusion is not of necessity correct. The unquestionable destruction of the white sea-bass in the northerly portion of its distributional area at least strongly suggests that the distributional area of the short-fin sea-bass also has shifted to the south. It should be noted that the mentioned authors worked in southern California waters during the beginning of the last decade of the last century, i.e., at the time when the white sea-bass was abundant around San Francisco. For further discussion of this interesting problem, see the section on the distribution of the white sea-bass.

Commercial Importance: The present commercial significance of this species is very slight, indeed. Small quantities, taken with hand lines or gill nets in Mexican waters, are sold in the fresh fish markets of southern California during fall, winter and spring. They are frequently recorded as white sea-bass by the fish dealers, although the fishermen do distinguish them from this species, usually under the erroneous name of "sea-trout," a name which they also apply to the young stages of the white sea-bass. It is said that the flesh is much inferior to that of the white sea-bass and that it does not stand transportation well.

Of course, it follows from what has been said above that at present this species is of no practical interest to sport fishermen.

SCIAENA (ARTEDI) LINNAEUS

Synonymy:

Sciaena Linnaeus. Linnaeus, Systema Natura, ed. 10, 1758:289.

Diagnosis: Body oblong to comparatively elongate, fairly compressed to little compressed, with back more or less elevated and ventral side more or less flattened, and with anterodorsal profile quite steep to not very steep. Snout blunt and somewhat protuberant. Mouth moderate in size to rather small, subinferior, only slightly oblique; lower jaw included; exposed part of maxillary fairly narrow, its posterior width 0.5 or less of eye. Suborbital area rather wide. Preopercle with crenulate, membranous edge; at least some serrae ossified, except in very young and old specimens. Snout with slits and large pores; chin with 5 large pores but without barbels. Lateral line nearly concurrent with back. Dorsal and anal fins of moderate height. Dorsal fins closely contiguous, their spines rather strong to slender; 9 or 10, usually 10, spines in first dorsal; base of second dorsal more than twice longer than that of anal. Spines of pectorals and pelvics usually weak, those of anal various. Anal, II, 7 or 8. Caudal various. Scales non-deciduous, fairly large. Head scaly, except ventrally and just in front of eyes and on lips, and often also on anterior portion of snout; its scales ctenoid, except on snout and sometimes below eyes. Teeth in both jaws closely set, in broad, villiform bands; all small, pointed and slightly bent inward, except the outermost in upper jaw which are decidedly enlarged. Lower pharyngeals separate, moderately wide; most teeth pointed, except in old specimens in which the strong ones are bluntish. Gill rakers more or less strong, rather short. Pseudobranchiae well developed. Air bladder large. Vertebrae, 10 + 14.

This genus, as conceived by Jordan and Evermann (1898, p. 1454), included numerous species, varying greatly among themselves and occurring mainly in the Old World. In addition, the delimitation of the genus was quite arbitrary and uncertain, and an attempt to subdivide the group met with apparently insuperable difficulties. The authors quoted from Jordan and Eigenmann in support of their conclusion that "in spite of the marked differences between the extremes of the series, the intergradation in characters is so perfect that we are unable to draw any sharp distinctive lines among them." In the check list published by Jordan, Evermann and Clark (1930), the opposite extreme has been adopted. In this work, there is no representative of *Sciaena* among the American species of this group; these species have been distributed among a number of other genera. Whether this new classification is correct or justifiable is impossible to decide at the present time; a very thorough revision of the genus must be carried out, based on intensive morphological studies. Since such an investigation has not as yet been undertaken, I have decided to maintain, tentatively, the classification offered by Jordan and Evermann (1898), especially since the names adopted by them have been accepted universally up till the present writing. In a letter from Dr. Evermann, I received the suggestion that *Sciaena saturna* should be assigned to the genus *Rhinoscion* and *Sciaena thompsoni* to *Ophioscion*.

Only the two species mentioned in the last paragraph occur in California, and of these *S. saturna* is uncommon and *S. thompsoni* is very rare; both are limited to the southern part of the State.

FIG. 6.

SCIAENA SATURNA (GIRARD)

Black Croaker

Synonymy:

Amblodon saturnus Girard, U. S. Pac. R. R. Survey, 1858, *10*:98; San Diego, California.

Corvina saturnus. Günther, Cat. Fish. Brit. Mus., 1860, *2*:298.

Rhinoscion saturnus. Gill, Proc. Acad. Nat. Sci. Phila., 1861, *13*:85; *op. cit.*, 1862, *14*:17.

Corvina (Johnius) jacobi Steindachner, Ichth. Beitr., 1879, *8*:3; San Diego, young specimens.

Sciaena jacobi. Jordan and Gilbert, Bull. U. S. Nat. Mus., 1882, *16*:571.

Sciaena saturna. Jordan and Gilbert, Bull. U. S. Nat. Mus., 1882, *16*:572.

Johnius saturnus. Jordan, Rept. U. S. Comm. Fish., 1885, (1887) :881 (*nomen nudum*).

Diagnosis: Lower jaw included. D. IX or X-I, 25 to 28. A. II, 7 or 8. Chin without barbels. Anal spines stout. Body fairly deep; greatest depth, 2.7-3.2. Dusky to blackish; angle of preopercle jet black.

Description: Body deepest somewhere between anterior and posterior ends of first dorsal and widest at or just behind posterior end of head; greatest depth, 3.0 (2.7-3.2); greatest width, 6.2 (5.6-6.6). Dorsal side very elevated, with back moderately compressed; ventral side usually rather flat. Anterodorsal profile steep, gently convex to gently concave above eyes; nape frequently bulging but sometimes gently convex. Snout (see Fig. 7 **A-E**) often subtruncate, sometimes rounded; usually but slightly protuberant, sometimes nearly as much protuberant as in figure 14 of *Umbrina roncador;* 3.3-3.8 in head. Maxillary reaches anterior margin or even middle of pupil; 3.2 (3.0-3.4) in head. Lower anterior edge of upper lip on level with a point 0.3-0.5 of eye below lower margin of eye. Suborbitals, 0.9 (0.8-1.0) of eye; somewhat wider, relatively, in large specimens. Margin of preopercle usually with rather small serrations, the posterior bony, the ventral membranous, hardly increasing in size toward posteroventral corner; as many as 22 posterior and 20 ventral serrae counted; sometimes distinct serrulation absent even in medium sized specimens. Eye rather large, relatively larger in small specimens; in specimens of 20-26 cm. body length, 1.3-1.8 in snout and 5.2-6.0 in head. Snout usually with 5 large pores arranged symmetrically in a transverse row fairly far from margin (see Fig. 7 **F**); and with 5 large pores near margin, also arranged symmetrically. Margin of snout usually with 2 slits connected with outer pores in lower row of pores. Sometimes 7 pores in upper row and only 3 pores in lower row; and there may be indications of 1 or 2 additional slits between normal slits. Chin with large pores arranged as in figure 7 **F**; covers lower lip anteriorly. First dorsal with IX or X, usually X, rather strong spines; first spine 0.15-0.25 of second, which is 0.7-0.9 of third, which usually is longest but may be slightly shorter than fourth; remaining spines gradually decrease in length posteriorly; the posterior 0.15-0.20 of third. Second dorsal, I, 27 (25-28); spine, 0.4-0.5 of first ray, which is 0.7-1.0 of second, which is 0.9-1.0 of third to seventh; remaining rays decrease in length posteriorly; the posterior 0.4-0.5 of the longest. Pectorals, I, 17 (16-18); spine, 0.25-0.40 of first ray, which is somewhat shorter than second; third and fourth or fourth and fifth rays longest. Pelvics: spine, 0.4-0.6 of first ray, which is longest and usually lacks a free, thread-like tip but may have a very short one; bases of pelvics separated by about 0.5-0.6 of eye. Anal, II, 7 (7 or 8); both spines stout; first spine, 0.20-0.25 of second, which is 0.7-0.9 of first ray, which is longest; remaining rays decrease in length posteriorly; the posterior 0.4-0.5 of first. Caudal usually gently lunate, sometimes truncate, its dorsal lobe slightly the longer; with 17 well developed rays. The statement in Jordan and Evermann (1898) that this fin is slightly convex possibly refers to young specimens; note that in beginning of

description these authors describe this fin as lunate. (See also Starks, 1919, fig. 12.) 52 (51-55) pores on lateral line of body; many pores sometimes covered with scales; 10 (9-11) scales above, 19 (17-21) below lateral line.[3] Bases of second dorsal and anal scaled.

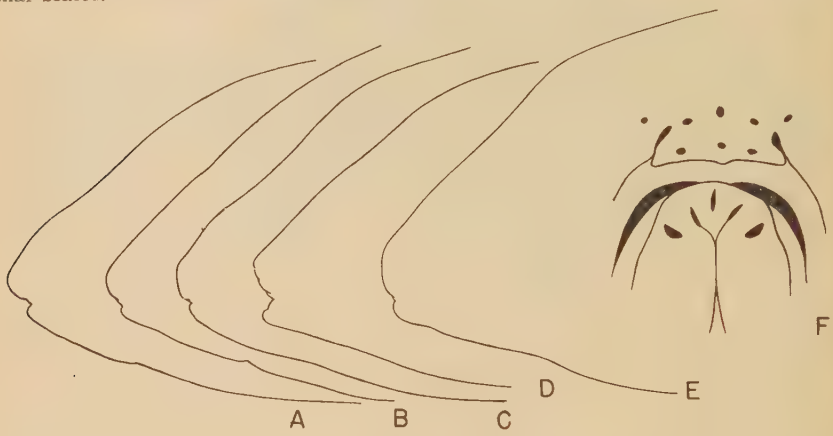

FIG. 7. Black croaker, *Sciaena saturna* (Girard). **A** to **E**, left lateral outline of head of specimens of a body length of about 20-26 cm., illustrating variation in shape of snout. **F** shows pores and slits around mouth. Upper lip above; two black crescents represent mouth.

Bands of teeth in upper jaw extend somewhat beyond middle of premaxillary, are of subequal width except in posterior one-third which tapers posteriorly, and meet anteriorly or nearly so; inner small teeth decrease slightly in size posteriorly and interiorly. In lower jaw, bands decrease in width posteriorly and do not meet at symphysis; all teeth small, decreasing somewhat in size posteriorly and interiorly. Gill rakers fairly or very strong, 8 (6-9) + 11 (8-14); middle one, 0.25-0.33 of eye; decrease gradually in length towards both extremities where they are very small, even hard to detect; on inside with a double irregular row of fairly numerous fine teeth. On inside of first arch, 13 (11-15) low knobs, each with numerous fine teeth; most knobs well developed, but some of the distal ones may be very small, hard to detect; in exceptional cases knobs are represented by continuous band of spiny incrustation. Pharyngeals of about same shape as in figure 12 **G**, of *Genyonemus*, but number 2 usually somewhat larger relatively. Most of the teeth of pharyngeals number 1 and several of the median teeth of lower pharyngeals fairly large and strong; some of the anterior teeth of pharyngeals number 2 sometimes also enlarged. Pyloric caeca, 8 (5-9), of medium size. Air bladder lacks anterior horns.

Color dusky to blackish, with reddish coppery reflections; belly silvery but obscured and dusted over with dark specks; an obscure, broad, pale band usually extends downward from front of soft dorsal to tips of pelvics, often fading with age; sides of head more brilliantly copper than elsewhere, with round dark spots; membrane about angle of opercle jet black. Fins dusky; tips of pelvics and anal black. Gill cavity and peritoneum dusky.

A medium sized fish reaching a body length of about 30 cm. (about 12 inches).

Proportions (in standard length):

Length of head	3.4 (3.3-3.6)
Distance from snout to base of pelvics	3.0 (2.9-3.2)
Distance from snout to vent	1.6 (1.5-1.7)
Distance from snout to anterior end of anal	1.5 (1.4-1.6)
Distance from snout to anterior end of first dorsal	3.2 (2.9-3.5)
Depth at posterior end of head	3.1 (2.9-3.4)
Depth at vent	3.5 (3.1-3.9)
Depth of peduncle	9.9 (8.7-10.9)
Length of first dorsal	4.8 (4.4-5.3)
Length of second dorsal	2.6 (2.5-2.7)
Length of pectorals	4.9 (4.7-5.3)
Length of pelvics	4.9 (4.5-5.7)
Length of anal	9.3 (8.4-10.2)
Length of caudal	4.8 (4.4-5.2)
Greatest height of first dorsal	7.0 (6.1-7.8)
Greatest height of second dorsal	8.8 (8.2-9.7)
Greatest height of anal	6.5 (5.9-7.4)

Measurements were made of 14 specimens of a body length of 20-26 cm., all from southern California.

[3] Starks and Morris (1907, p. 198) write that there are 70 scales (pores) in the lateral line, while the descriptions up till that date state that there are 55-60. As will be seen from my description, I found 51-55 in the 14 specimens examined for this report. It should be noted that this character is extremely difficult to establish with full certainty, due to the duskiness of the skin and to the fact that the lateral line continues out on the caudal fin where it ends in a fairly indefinite manner.

General Range: Coast of California and west coast of Mexico, from Point Conception southward into the Gulf of California.

Occurrence in California: Apparently fairly rare and restricted to the southern part of the State; not recorded north of Santa Barbara. It usually lives near the bottom, seems to prefer sandy bottom and fairly shallow water, and is found not only along the open coast but also in enclosed bays, such as San Diego Bay. Occasionally a few specimens are taken just outside the big kelp beds by gill net and lampara fishermen.

Food: In most of the specimens examined, the stomach was full of different kinds of shrimps and small crabs. No fish or worms were found, but in all probability the food also includes these forms, even though crustaceans may make up the great bulk of the food.

Breeding: The spawning appears to take place at about the same time as in the case of the yellowfin croaker, i.e., during the summer months. Maturity is apparently reached when a body length of about 22 cm. is attained.

Commercial Importance and Sport Fishing: As is the case in regard to most of the croakers, this species plays no part in the fresh fish trade. Due to its rare occurrence, it was seen very seldom in the markets even when legal. It is taken irregularly throughout the year with different types of nets such as gill nets, round haul nets and beach seines. Since 1933, it has been illegal to sell or buy this species.

Sport fishermen catch the species with hook and line, both from piers along the open coast and in bays and sloughs. However, since it is so extremely rare in the catch, it has little significance to these men, even though it is quite an excellent table fish. It is taken with soft-shell sand crabs or some other bait used for other croakers.

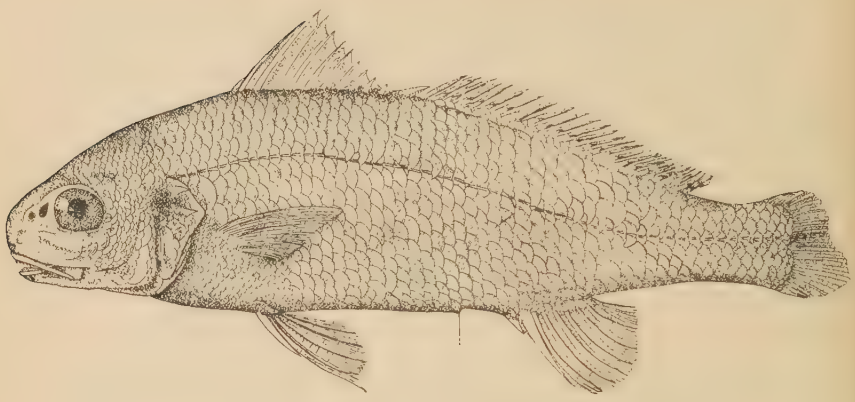

FIG. 8. Reproduction of illustration, Hubbs (1921)

SCIAENA THOMPSONI HUBBS

Thompson's Croaker

Synonymy:

Sciaena thompsoni Hubbs, Occ. Pap. Mus. Zool. Univ. Michigan, 1921, (92) :1-3.

Diagnosis: Lower jaw included. D. X-I, 28. A. II, 7. Chin without barbel. Anal spines stout. Body fairly slender; greatest depth, 3.4-3.5. Angle of preopercle dark.

Description: Body comparatively elongate and little compressed, deepest somewhere between anterior and posterior ends of first dorsal; greatest depth, about 3.5. Dorsal side not very elevated but well convex, with back behind head compressed; ventral side flattened. Anterodorsal profile moderately steep, gently convex, with slight depression above eye. Snout bluntly rounded, slightly protuberant, 3.6 in head. Maxillary reaches slightly beyond middle of pupil, 2.7 in head. Lower anterior edge of upper lip on level with a point about 0.5 of eye below lower margin of eye. Suborbitals, about 0.7 of eye. Preopercle with about 29 rather small, bony, marginal serrations, not much enlarged at angle, becoming minute at both extremes of series. Eye large, 4.1 in head in specimen 10 cm. long to caudal. First dorsal with 10 rather slender spines; first spine about 0.20 of second, which is 0.9 of third, which is the longest; remaining spines decrease in length posteriorly; the posterior about 0.15 of third. Second dorsal, I, 28; spine, 0.5 of first ray, which is about 0.9 of fourth ray which is the longest; remaining rays decrease slightly in length posteriorly; the posterior about 0.4 of fourth. Pectorals, I, 17. Pelvics: spine, 0.5-0.6 of first ray, which is the longest and produced in a short filament. Anal, II, 7; both spines stout; first spine, 0.25 of second which is 0.8 of first ray, which is the longest; remaining rays decrease in length posteriorly; the posterior about 0.5 of first. About 50 pores on lateral line of body; about 8 scales above and 13 below lateral line. Bases of second dorsal and anal scaly.

Gill rakers, 7 + 13, the longest not quite so long as pupil. Color unknown. Opercle with large dark spot. Gill cavity dusky.

Body length, 10 cm. (about 4 inches).

Proportions (in standard length):

Length of head	3.9
Distance from snout to base of pelvics	3.0
Distance from snout to vent	1.7
Distance from snout to anterior end of anal	1.5
Distance from snout to anterior end of first dorsal	3.3
Depth at posterior end of head	3.7
Depth at vent	3.9
Depth of peduncle	9.9
Length of first dorsal	4.9
Length of second dorsal	2.5
Length of pectorals	6.0
Length of pelvics	5.7
Length of anal	8.6
Greatest height of first dorsal	7.3
Greatest height of second dorsal	13.0
Greatest height of anal	7.4

Measurements made from Hubbs' figure of type specimen.

Of this species, only one specimen has been recorded. Type-locality: Santa Catalina Island, southern California. The members of the California State Fisheries Laboratory have searched the fish markets of southern California for this species, but in vain, a fact that indicates that this form is very rare; it may even be only a rare guest.

RONCADOR JORDAN AND GILBERT

Synonymy:

Roncador Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 3:28; (*Corvina stearnsi* Steindachner).

Diagnosis: Body oblong, much compressed; back elevated and compressed; ventral side more or less flattened; anterodorsal profile steep. Snout rather bluntly rounded, somewhat protuberant. Mouth moderate in size, subinferior, only slightly oblique; lower jaw included; exposed part of maxillary rather narrow, its posterior width 0.4 or less of eye. Suborbital area moderately wide. Posterior margin of preopercle with many short stout spines. Snout with slits and large pores; chin with 5 large pores but without barbels. Lateral line nearly concurrent with back. Dorsal and anal fins of moderate height. Dorsal fins closely contiguous, their spines strong; about 10 spines in first dorsal; base of second dorsal more than twice longer than that of anal. Spines of pectorals and pelvics weak; those of anal stout. Anal, II, 8 or 9. Caudal gently lunate to truncate. Scales nondeciduous, rather large. Head scaly, except ventrally, and just in front of eyes and on lips; all its scales ctenoid. Teeth in both jaws closely set in broad villiform bands; all small, pointed, slightly bent inward. Lower pharyngeals separate, rather wide, with large number of rounded molars. Gill rakers slender and rather long. Pseudobranchiae well developed. Air bladder large. Vertebrae, 10 + 14.

The species described below is the only member of this genus recorded up till the present time.

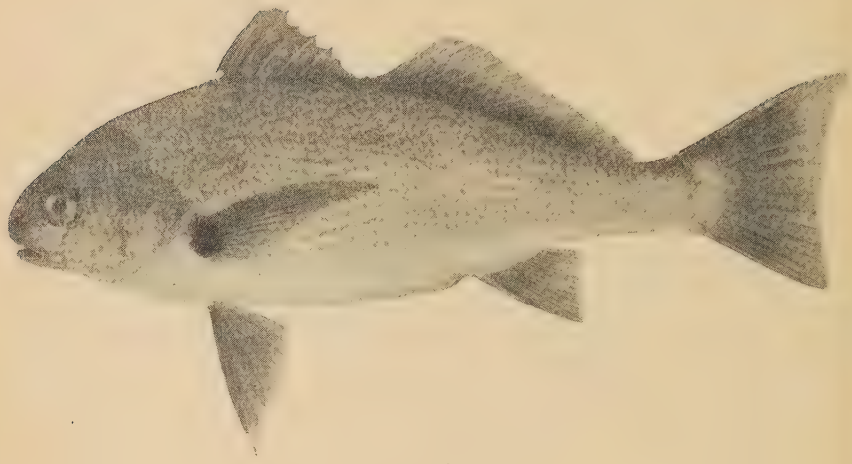

FIG. 9.

RONCADOR STEARNSI (STEINDACHNER)

Spotfin Croaker

Synonymy:

Corvina stearnsi Steindachner, Ichth. Beitr., 1875, *3*:22; San Diego.
Roncador stearnsi. Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, *3*:28 (*gen. nov.*).
Sciaena stearnsi. Jordan and Gilbert, Bull. U. S. Nat. Mus., 1882, *16*:572.

Diagnosis: Lower jaw included. D. X-I, 21 to 24. A. II, 8 or 9. Chin without barbels. Anal spines stout. Grayish silvery, with bluish luster; a large black spot at base of pectorals, extending on outside as well as inside of fin and on body just behind pectoral base.

Description: Body deepest somewhere between anterior and posterior ends of first dorsal and widest at posterior end of head or at bases of pelvics; greatest depth, 3.3 (3.0-3.6); greatest width, 6.4 (4.9-7.2); relative width increases somewhat with age; specimens of about 30 cm. body length or more have usually a width of at least 5.5 (17 of my 20 specimens less than 23 cm. long; hence average comparatively low). Dorsal side much more convex than ventral; elevation sometimes even more pronounced than in figure 9. Anterodorsal profile usually gently concave above eye but may be evenly convex. Snout usually quite blunt but is often somewhat more protuberant and pointed than in figure 9 (never so much as in figure 14 of *Umbrina roncador*); 3.3-4.1 in head. Maxillary extends to just in front of middle or even to posterior margin of pupil; 3.0 (2.8-3.4) in head. Lower anterior edge of upper lip on level with a point about 0.4-0.6 of eye below lower margin of eye. Suborbitals, 0.66-1.0 of eye; somewhat wider relatively in large specimens. Posterior margin of preopercle with 19 (16-22) stout bony spines, increasing in size ventrally; the dorsal ones very small, the ventral several times larger; ventral margin sometimes with well developed, fine crenulation and a few bony spines, sometimes smooth or nearly so. Eye of moderate size, relatively somewhat larger in small specimens; in specimens of 11-16 cm. body length, 1.0-1.3 in snout and 4.0-4.7 in head; in specimens about 43 cm. long, even 1.7 in snout and 6.3 in head. Snout usually with 5 large pores arranged symmetrically in transverse row fairly far from margin (see Fig. 10A); middle pore may be composed of 2 smaller pores and any one of the others may exceptionally also be split into 2 closely set pores. Near margin of snout, 3 large pores, also arranged symmetrically. Margin with 4 slits, the 2 outer usually connected with the 2 outer of the 3 pores near margin. Pores of chin arranged as in figure 10A. First dorsal, X; first spine, 0.13-0.20 of second, which is 0.75 (0.60-0.90) of third, which usually is longest but may be slightly shorter than fourth; remaining ones decrease in length posteriorly; the posterior about 0.20-0.22 of third. Second dorsal, I, 23 (21-24); spine, 0.3-0.5 of first ray, which is subequal to next 7 rays; remaining rays decrease in length posteriorly; the posterior 0.4-0.5 of the longest. Pectorals, I, 17 (16-18); spine, 0.25-0.35 of first ray, which is somewhat shorter than second; fourth and fifth usually longest. Pelvics: spine, 0.5 (0.5-0.6) of first ray, which is longest and produced in rather short threadlike tip; bases of pelvics separated by about 0.4-0.6 of eye. Anal, II, 8, seldom 9; first spine, 0.20-0.25 of second, which is 0.6-0.7 of first ray, which is longest or subequal to second; remaining rays decrease in length posteriorly; the posterior about 0.4 of first ray. Caudal usually gently lunate, with dorsal lobe slightly the longer, seldom truncate; with 17 well developed rays. 53 (52-55) pores on lateral line of body; 7-9 scales above, 14-16 below lateral line. Soft dorsal and anal scaleless.

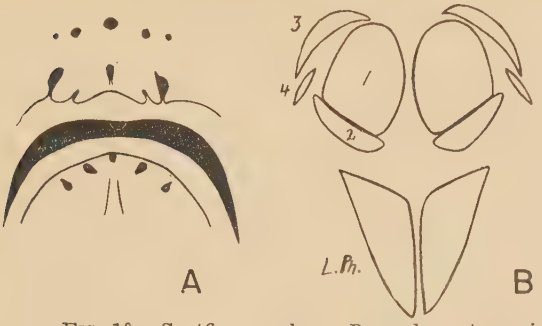

FIG. 10. Spotfin croaker, *Roncador stearnsi* (Steindachner). **A** shows pores and slits around mouth. Upper lip above; black crescent indicates the mouth. **B** illustrates relative size, shape and position of pharyngeals. The upper ones are numbered; the lower ones indicated by "L. Ph."

Bands of teeth in upper jaw extend somewhat beyond middle of premaxillary, are of subequal width nearly throughout, and meet anteriorly or nearly so; teeth decrease gradually in size posteriorly and interiorly, but even outer, anterior teeth quite small. In lower jaw, bands decrease in width posteriorly and do not meet at symphysis; teeth as in upper jaw. Gill rakers, 13 (10-14) + 16 (15-19); middle one, 0.30-0.35 of eye in small specimens and 0.4-0.6 of eye in large; decrease gradually in length toward both extremities, where they are short, sometimes even hard to detect; each has on inside a double irregular row of fairly numerous fine teeth. On inside of first arch, 17 (15-19) well developed knobs, each with numerous fine teeth. Shape of pharyngeals about as in figure 10**B**, but number 2 and lower pharyngeals sometimes about as in figure 12**G** of *Genyonemus*. Inner two-thirds of pharyngeals number 1 armed with strong rounded molars; other parts of upper pharyngeals have small pointed teeth; of lower pharyngeals, posterolateral corners have small fine teeth, rest with strong rounded molars except for a series of small teeth along outside. Pyloric caeca, 10 (9-12) medium size. Air bladder lacks anterior horns.

Color grayish silvery, with bluish luster; light below. Some specimens when alive most distinctly golden, with no bluish or silver luster. Wavy dark lines follow rows of scales, extending upward and backward (less conspicuous than in *Umbrina roncador*). A large black spot at base of pectoral, extending on outside and inside of fin and on body just behind base of fin. Two dusky streaks sometimes extend from throat to pelvics and thence to each side of anal. These streaks were present in only one of my 25 specimens and this was the largest of the lot (body length 43 cm.) and a recently spent female. Gill cavity and peritoneum blackish.

A fairly large fish, reaching a body length of about half a meter (about 19 inches) and a weight of 7 pounds. Sportsmen have reported a few specimens weighing as much as 10 pounds.

One of the noisiest of the croakers.

Proportions (in standard length):

Length of head	3.8 (3.6-4.3)
Distance from snout to base of pelvics	3.3 (3.0-3.5)
Distance from snout to vent	1.6 (1.6-1.7)
Distance from snout to anterior end of anal	1.5 (1.5-1.6)
Distance from snout to anterior end of first dorsal	3.2 (3.0-3.5)
Depth at posterior end of head	3.5 (3.3-3.8)
Depth at vent	3.9 (3.6-4.4)
Depth of caudal peduncle	10.1 (9.6-10.9)
Length of first dorsal	4.4 (4.1-5.1)
Length of second dorsal	2.8 (2.6-3.0)
Length of pectorals	3.9 (3.4-4.5)
Length of pelvics	4.8 (4.4-5.2)
Length of anal	8.9 (7.8-10.5)
Length of caudal	4.7 (4.4-5.0)
Greatest height of first dorsal	6.7 (6.2-7.5)
Greatest height of second dorsal	8.3 (7.3-9.8)
Greatest height of anal	6.5 (5.9-7.5)

Measurements were made of 3 specimens of a body length of 31-43 cm., and of 17 specimens, 11-23 cm. long. All specimens were taken in southern California.

General Range: Recorded from Point Conception, California, to the border of Mexico. It has not as yet been scientifically recorded from the west coast of Lower California, but there can hardly be any doubt that it penetrates somewhat to the south along this coast. (Unconfirmed reports give Ensenada a record locality.) In all probability, it has about the same distribution as *Umbrina roncador*.

Occurrence in California: This species is fairly common along the coast of southern California, from Point Conception in the north to

the Mexican border, sometimes occurring in quite large abundance. The only record north of Point Conception is one of Jordan, who found a single specimen in the San Francisco fish markets (Starks and Morris, 1907, p. 199). For reasons given in the corresponding section of *Umbrina roncador,* this record should be considered as uncertain. If the species does occur north of Point Conception, it is probably represented there only by a few stragglers.

It is a shallow water fish, preferring sandy beaches and sloughs, and it appears usually not to exceed a depth of about 20-30 feet; it may be seen near the surface. It evidently is seasonal in occurrence. Starks and Morris (1907) found it to be common in San Diego Bay in the latter part of July, "though it was not seen before that time." This indicates at least a limited migration, and the species may well retreat into somewhat deeper waters during the cooler seasons.

Food: Mainly crustaceans and mollusks. In some of the specimens examined by me, the stomach was found to be full of small crushed clams. It should be noted that the pharyngeals are excellently adapted to crush hard food, the inner two-thirds of these structures being armed with strong rounded molars.

Breeding: The species probably has about the same spawning season as has the yellowfin croaker. Spent females were found in the latter part of the summer. The specimens appear not to reach sexual maturity until they have attained a body length of at least 23-24 cm.

Commercial Importance and Sport Fishing: According to present laws, it is unlawful to take the spotfin croaker with nets (since 1909) and to sell and buy it (since 1915); it is thus entirely reserved for sport fishing.

Although the species is taken during the entire year, nevertheless it appears to be decidedly seasonal in occurrence, late summer being by far the season of best success for the sportsmen. Most of the fishing is carried on along the sandy beaches, in the bays, and from pleasure piers and small boats. Surf fishing is frequently undertaken for the special pleasure of catching this species. A peculiarity of the spotfin croaker is that it tends to aggregate in so-called "croaker-holes," depressions in the sandy bottom somewhat outside the zone of the breakers. In these "holes" they often occur in very great numbers and large catches sometimes reward the devotees of this sport. One of the most famous "holes" is located at San Onofre. The spotfin are taken successfully along rocky breakwaters and in bays, principally in Mission Bay and Newport Bay. Late afternoons and evenings seem to be best suited for this sport. Soft-shell sand crabs, clams, mussels and pile worms are preferred as bait. Surf fishermen frequently first try the inner surf for corbina; then the outer breakers and beyond for spotfin. And they often use baits as follows: for corbina in the near breakers, pile worms; for spotfin in far breakers, soft-shell sand crabs; for spotfin beyond breakers, mussels. Mussels, however, seem to be effective everywhere. The sizes range up to 6 or 8 pounds, but anything over two pounds creates enthusiasm. The beauty of this species, its fine fighting spirit and delicate taste are qualities which have swelled the ranks of the enthusiasts for this sport.

GENYONEMUS GILL

Synonymy:

Genyonemus Gill, Proc. Acad. Nat. Sci. Phila., 1861, *13*:87 (*Leiostomus lineatus* Ayres).

Diagnosis: Body comparatively elongate, moderately compressed; back little compressed; with moderately and usually subequally convex dorsal and ventral sides; anterodorsal profile not very steep. Head subconical; snout variable, usually blunt and but slightly protuberant. Mouth moderate in size, subinferior, rather slightly oblique; lower jaw included; exposed part of maxillary moderate in width, its posterior width 0.6 or less of eye. Suborbital area moderately wide. Preopercle with crenulate membranous edge; at least some serrae have weak ossifications. Snout with slits and large pores; chin with 5 large pores and several minute barbels. Lateral line nearly concurrent with back. Dorsal and anal fins of moderate height. Dorsal fins closely contiguous, their spines rather slender; 12 or more spines in first dorsal; base of second dorsal more than twice longer than that of anal. Spines of pectoral, pelvic and anal fins weak. Anal, II, 11 or 12. Caudal lunate. Scales rather deciduous, of moderate size. Head scaly, except ventrally and just in front of eyes and on lips; its scales ctenoid, except on snout and suborbital area. Teeth of both jaws closely set, in broad villiform bands; all small, pointed, slightly bent inward. Lower pharyngeals separate, moderately wide; teeth pointed. Gill rakers slender, moderately long. Pseudobranchiae well developed. Air bladder large. Vertebrae, 11 + 14.

This genus contains a single described species.

FIG. 11.

GENYONEMUS LINEATUS (AYRES)

Kingfish

Synonymy:

Leiostomus lineatus Ayres, Proc. Cal. Acad. Sci., 1855, *1*:25; San Francisco.
Sciaena lineata. Günther, Cat. Fish. Brit. Mus., 1860, *2*:288.
Genyonemus lineatus. Gill, Proc. Acad. Nat. Sci. Phila., 1861, *13*:89; *op. cit.*, 1862, *14*:17 (*nomen nudum*). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, *3*:456.

Diagnosis: Lower jaw included. D. XII to XV-I, 21 to 24. A. II, 11 or 12. Chin with several minute barbels. Anal spines weak. Silvery, with brassy luster; a small but quite conspicuous black spot on inside of pectoral, at upper corner of base, slightly extending on body.

Description: Body deepest somewhere between anterior and posterior ends of first dorsal and widest at posterior end of head or at bases of pelvics; greatest depth, 3.8 (3.5-4.0); greatest width, 6.4 (5.5-7.5); these proportions nearly the same in large and small specimens but the small ones are slightly narrower relatively. Dorsal and ventral sides usually subequally convex, but either may be strikingly more convex than the other. Anterodorsal profile (see Fig. 12, **A-F**) usually flattened to slightly concave above eye but may be gently and evenly convex; in front of eye it may be evenly and rather abruptly decurved or gently sigmoid to somewhat irregular, being characterized by one or two low but rather conspicuous humps. Snout usually rather blunt, but may be somewhat pointed, 3.7-4.3 in head. Maxillary usually extends to somewhere between middle and posterior margin of pupil, in extreme cases as far back as to posterior edge of eye, 2.9 (2.8-3.0) in head. Lower anterior edge of upper lip on level with a point 0.3-0.5 of eye below lower margin of eye. Suborbital area, 0.7 (0.5-0.8) of eye. Along posterior margin of preopercle crenulation is fine, increasing but slightly in size ventrally; as many as 25 serrae counted; along ventral margin less distinct; crenulation sometimes nearly absent in old specimens. Eye relatively larger in small specimens; in specimens of 10 cm. body length, about 1.0-1.2 in snout and 4.5-4.7 in head; in specimens 30 cm. long, about 2.0 in snout and 7.5 in head. Snout usually with same number and arrangement of pores and slits as in figure 10A of *Roncador stearnsi;* however, inner two slits may be absent or these two slits are absent and the lower middle pore is connected with margin by means of an extra slit; or the middle upper pore may be doubled. Pores of chin arranged as in figure 10A of *Roncador stearnsi.* Barbels in 2 series, 2-5 in each series; sometimes so small as to be readily overlooked, especially in fresh specimens. First dorsal, XII-XV, usually XIII or XIV; exact number sometimes difficult to establish, since in second dorsal, spine may be ray-like or first ray spine-like; first spine, 0.20 (0.14-0.30) of second, which is 0.70 (0.45-0.90) of third, which may be slightly longer or shorter than fourth; remaining spines decrease in length posteriorly; the posterior, 0.12-0.18 of the longest. Second dorsal, I, 22 (21-24); spine, 0.4 (0.3-0.5) of first ray, which is 0.8 (0.6-0.9) of second, which is subequal to or slightly longer than the third to the sixth; remaining rays decrease slightly in length posteriorly; the posterior, 0.4-0.6 of the longest. Pectorals, I, 17 (16-19); spine, 0.25 (0.20-0.33) of first ray, which is somewhat shorter than second; fourth and fifth usually longest. Pelvics: spine, 0.5 (0.4-0.6) of first ray, which is longest and has a moderately long, free, thread-like tip; bases of pelvics separated by about 0.4-0.6 of eye. Anal, II, 11 or 12, usually 11; first spine, 0.25 (0.20-0.35) of second, which is 0.4-0.5 of first ray, which is subequal to or slightly shorter than second ray; remaining rays decrease in length posteriorly; posterior, 0.4-0.5 of first. Caudal with 17 well developed rays. 52-54 pores on lateral line of body; 7-9 scales above, 14-16 below lateral line. Soft dorsal and anal scaleless.

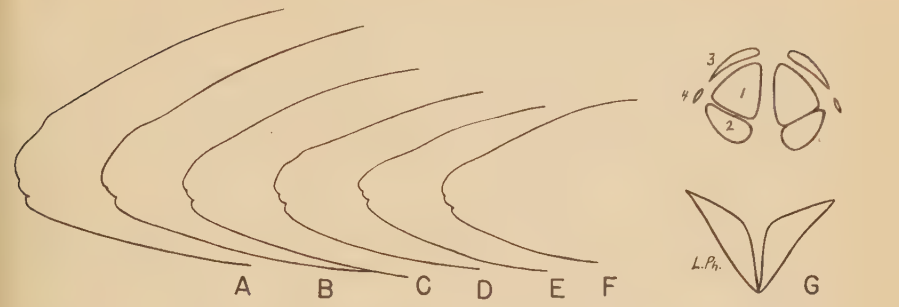

FIG. 12. Kingfish, *Genyonemus lineatus* (Ayres). **A** to **F**, left lateral outlines of head region, illustrating variations in the profile. **G** shows relative size, shape and position of pharyngeals. The upper ones are numbered; the lower ones are indicated by "L. Ph."

Bands of teeth in upper jaw extend somewhat beyond middle of premaxillary, are subequal in width except in poster.or one-third which tapers posteriorly, and meet anteriorly or nearly so; teeth decrease gradually in size posteriorly and interiorly but even the outer anterior teeth are quite small. In lower jaw, bands decrease in width posteriorly and do not meet at symphysis; teeth as in upper jaw but more uniform in size. Gill rakers, 12 (10-13) + 19 (18-20); middle one, 0.4 (0.3-0.5) of eye, somewhat longer relatively to eye in large specimens than in small; decrease gradually in length towards both extremities where they are short, sometimes even hard to detect; each has on inside a double irregular row of fairly numerous fine teeth. On inside of first arch, 19 (17-21) well developed knobs, each with numerous fine teeth. Shape of pharyngeals about as in figure 12**G**; lower pharyngeals of narrow triangular shape. Inner two-thirds of pharyngeal number 1 with rather large and strong, though fairly well pointed, teeth; other parts of upper pharyngeals have small teeth; median teeth of lower pharyngeals also rather large, strong and well pointed, the rest small. Pyloric caeca, 7-9, of moderate size. Air bladder lacks anterior horns.

Color silvery, with brassy luster and fine black punctulations; light below. Faint wavy lines follow rows of scales upward and backward. Fins, except the ventrals, usually yellowish; first dorsal somewhat dusky. A small, but quite conspicuous black spot on inside of pectoral, at upper corner of base extending slightly on body. Gill cavity dusky; peritoneum whitish.

A comparatively small fish; maximum length of body about 33 cm. (about 13 inches); maximum weight nearly 600 grams (about a pound and a quarter).

Proportions (in standard length):

Length of head	3.4 (3.2-3.6)
Distance from snout to base of pelvics	3.1 (2.9-3.3)
Distance from snout to vent	1.5 (1.5-1.6)
Distance from snout to anterior end of anal	1.4 (1.4-1.5)
Distance from snout to anterior end of first dorsal	3.0 (2.8-3.3)
Depth at posterior end of head	4.0 (3.6-4.3)
Depth at vent	4.5 (4.2-5.0)
Depth of peduncle	11.0 (10.2-11.6)
Length of first dorsal	4.1 (3.8-4.7)
Length of second dorsal	3.3 (3.0-3.6)
Length of pectorals	4.1 (3.9-4.5)
Length of pelvics	4.8 (4.3-5.5)
Length of anal	7.6 (6.1-8.8)
Length of caudal	4.8 (4.3-5.3)
Greatest height of first dorsal	5.8 (5.3-6.7)
Greatest height of second dorsal	8.1 (6.5-9.4)
Greatest height of anal	7.6 (6.1-8.5)

Measurements were made of 14 specimens from Monterey Bay and of 7 specimens from San Pedro, southern California. Of these specimens, 1 had a body length of about 30 cm., the rest were between 10 and 24 cm. long.

General Range: Coast of California and west coast of Mexico, from somewhere to the north of San Francisco (see the next section) to San Quentín, 150 miles south of the international boundary, or possibly as far to the south as to Cerros Island, i.e., near the middle of Lower California (Jordan and Evermann, 1898, p. 1460).

Occurrence in California: The kingfish is common along the coast of California, from the region around San Francisco to the Mexican border. San Francisco is usually given as the northernmost distributional limit of the species, but according to the records of the California Division of Fish and Game, it was taken in 1929 in Mendocino County and in 1932 there were 695 pounds landed in Del Norte County.

In other words, even though the species is usually not taken north of the San Francisco region, on rare occasions it may penetrate as far as to the neighborhood of the northern boundary of the State. Judging by the catch records, the kingfish is most common in the Los Angeles region. The catch north of Point Conception during the last twenty years amounted to, on the average, one-third of the State total. The landings at San Diego appear always to be small; for example, in 1933, 347,453 pounds were landed in Los Angeles County, whereas only 1643 pounds were entered at San Diego. For 1934 and 1935, the corresponding values were 346,177 and 4613 pounds, and 476,286 and 3894 pounds, respectively. This enormous difference in landings at the two ports appears to necessitate the assumption of a difference in the density of the kingfish population in the respective areas. This assumption is made still more plausible by the fact that the species appears to reach its southernmost limit, at least as a reasonably common form, near Todos Santos Bay, which is located not very far to the south of the Mexican boundary. However, the matter of fact is that kingfish are very common around San Diego. The small landings at San Diego evidently are due to the circumstance that there are no lampara boats doing general market fishing. The nets are used only for sardines and mackerel, hence few kingfish are caught.

According to Starks (1919), this species should be more common (available) in the summer than in the winter in southern California. However, this statement is apparently contradicted by the records of the California Division of Fish and Game, as shown in table 6.

TABLE 6

Monthly Landings of Kingfish in Los Angeles County, 1923-1927, Expressed in Percentage of Average Annual Catch for County

January	11.9	July	2.5
February	12.8	August	3.1
March	11.3	September	5.9
April	9.1	October	9.6
May	6.1	November	11.0
June	6.0	December	10.7

This table shows that although the species is taken during the entire year, nevertheless the winter and early spring (November to March) is the season of the heaviest catches and the summer months of July and August are the months of greatest scarcity; in other words, just the opposite to the seasonal distribution given by Starks. Whether this uneven distribution of the catch is due to fluctuations in the available supply or to differences in the intensity of the fishing operations is not known. It should be noted that there is, generally speaking, a decrease in the operations for the lower priced fish species (such as kingfish) during the summer, due largely to the intensive concentration on the tuna, yellowtail and barracuda fisheries. Since the kingfish is available during all months of the year along its entire range, fluctuations in the available supply, if these occur, would possibly be due to slight migrations back and forth between the shallow waters near the shore and somewhat deeper waters. It may be noteworthy in this connection that the largest catches are made during the period of heaviest spawning.

The kingfish, which usually prefers the waters somewhat above the bottom, can frequently be seen close to the surface. It has a con-

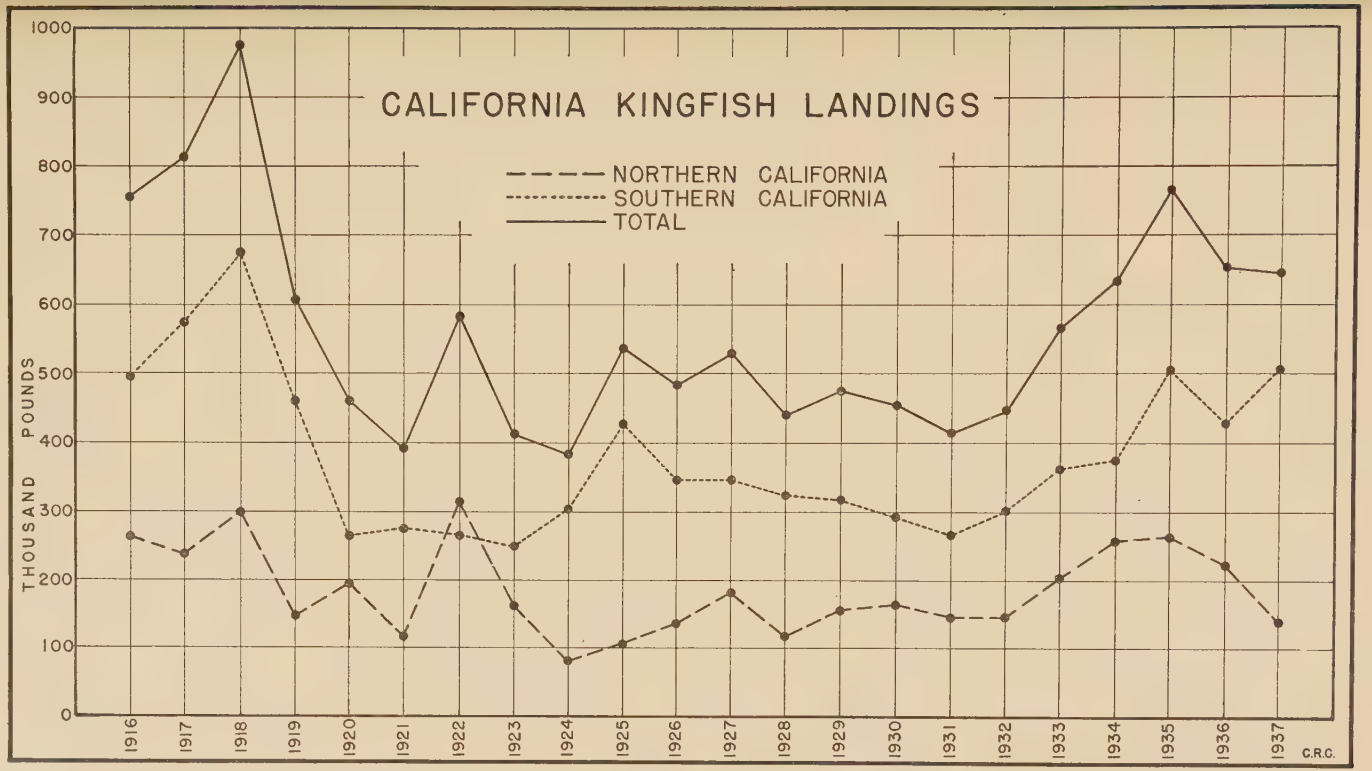

FIG. 13. Commercial landings of kingfish in California, 1916 to 1937, inclusive. For the purpose of this graph, "Northern California" includes all the coastal counties from Monterey County north; "Southern California" includes all the counties from San Luis Obispo County south. The most important county for kingfish landings in the north is Monterey. In the south Los Angeles County is most important. Negligible amounts of queenfish are included in the kingfish catch.

siderable vertical range and in addition a peculiar and as yet unexplained differential vertical distribution. In some places it is common in shallow water; and in other localities it is rare in shallow water but very common at a depth of about 180 to 200 feet. It appears usually in small schools, often mixed with queenfish and other small fish, swimming around along or somewhat above the bottom. Sometimes it aggregates into large schools, as will be seen from the fact that sardine fishermen in Monterey Bay on one occasion caught not less than 80,000 pounds in one day (Scofield, 1924).

Food: The food consists mainly of various kinds of invertebrates living on or in the sandy bottom; for instance, annelid worms, small shrimps (*Crago,* etc.), crabs, and mollusks (small thin-shelled clams, scaphopods or tooth shells, etc.). The species is voracious and in general seems to be ready to eat anything coming within reach.

Breeding: The breeding appears to begin in November and to last until May; January, February and March seem to be the heaviest spawning season. Sexual maturity is apparently reached at a body length of about 13-15 cm.

According to Starks and Morris (1907, p. 199), "the young from one and one-half to three inches in length differ from the adults in having a rather strong spine at the angle of the preopercle, with a weaker one above and below. The oblique dark stripes are absent, but there are about twelve wide, dark, vertical bars on side of body and head, which often extend on to the back." This is the only information we have in regard to the younger stages.

Commercial Importance and Sport Fishing: The kingfish is a food fish of some importance. Its flesh is usually quite palatable, but since it is rather soft and does not keep well, the market demand is very limited and the price therefore comparatively low. Many people consider this species worthless as food because they believe it to be "wormy." This opinion is hardly justified. First of all, the parasites which it does contain are, at least as far is is known, not dangerous to man, and they are all killed by thorough cooking. In addition, I have investigated a number of specimens of kingfish and found that at least these contained fairly few parasites.

Table 7 gives the amounts of this species sold in the fresh fish markets of California from 1916 on, according to the records of the California Division of Fish and Game. This table includes very small quantities caught in Mexican waters, usually less than 1000 pounds a year although 8100 pounds of Mexican kingfish was landed in 1923.

Figure 13 gives a graphical representation of the values included in table 7. From these data it will be seen that the average yearly consumption from the year 1920 has been slightly more than 500,000 pounds, ranging roughly between 400,000 and 800,000 pounds. The large catches made in 1916, 1917 and 1918 undoubtedly were caused by the increased demand for sea food created by the World War. The largest annual catch (in 1918) was 975,100 pounds; and the smallest (in 1924) was 384,300 pounds. Small amounts not recorded as kingfish but included in the sardine statistics used to be taken accidentally by the sardine fishermen and diverted from the fresh fish markets into the

TABLE 7

Landings of Kingfish in California*

Year	Southern California pounds	Northern California pounds	Total
1916	495,000	262,300	757,300
1917	573,000	239,000	812,000
1918	674,900	300,200	975,100
1919	460,900	148,300	609,200
1920	264,900	196,600	461,500
1921	274,600	116,500	391,100
1922	266,300	315,600	581,900
1923	249,800	161,800	411,600
1924	303,400	80,900	384,300
1925	429,000	107,700	536,700
1926	347,600	137,300	484,900
1927	348,100	181,200	529,300
1928	323,500	118,300	441,800
1929	319,300	157,200	476,500
1930	292,200	165,000	457,200
1931	267,900	146,100	414,000
1932	301,200	146,300	447,500
1933	361,500	202,700	564,200
1934	376,100	258,300	634,400
1935	505,200	263,500	768,700
1936	429,400	222,700	652,100
1937	505,700	140,100	645,800

* Figures rounded off to the nearest hundred pounds.

canneries where they were turned into fertilizer. Nowadays, kingfish are but seldom seen in the sardine catches, due to the fact that on the average the modern purse seine operations are carried out somewhat farther from the shore than the operations in the time when the lampara nets were the exclusive or the principal gear in the sardine fishery.

By far the most important port of entry in the kingfish fishery is San Pedro (Los Angeles Harbor), where about 60 per cent of the total catch for California is landed. The ports of entry next in importance are San Francisco, Monterey and Santa Cruz.

In regard to the seasonal distribution of the catch, see the above section on the occurrence in California.

Commercial fishing is carried out largely by round haul nets, gill nets and drag nets. Especially in the last type of fishing, kingfish are taken accidentally among other more desirable species such as sole and sand dabs. A limited amount of hook and line fishing for kingfish is also done.

The kingfish is not protected by law. However, the limited demand for the species in the fresh fish markets forms its best protection against overfishing. There is probably at present no danger of depletion.

Tons and tons of kingfish are caught by sportsmen from barges that take out tourists for "deep sea fishing" and from piers and wharves both along the open coast and in sheltered bays. In the last few years, about 75 per cent of the total sport catch of this species was taken from the "deep sea" barges or from small boats fishing somewhat outside the surf zone. The species is one of the easiest to catch with hook and line, due to its voracious nature and its abundance in a variety of habitats. Every kind of bait or lure used for desirable species of fish up to twice the size of the kingfish, attracts the kingfish and causes their capture. The sportsmen nearly always consider the species rather a nuisance than an object of sport, and the specimens they catch are usually left to spoil. In other words, it is not a sport

fish in the true sense of the word; nobody wants to catch them but everybody does. Most of the southern California sportsmen call the species "tomcod," which is of course a misnomer, but many of them call it derisively "Pasadena trout," which evidently is not appreciated by the inhabitants of this city, who in their turn scornfully refer to it as "Glendale trout." The reason for the low standing of this fish is evidently the softness of the flesh and the idea that it is "wormy." Late afternoons appear to yield the best catches, which is unfortunate since some of the desired croakers appear to have the same characteristic, but any time and nearly any reasonable place will give results. It is the only croaker taken from the wharves in central California.

In at least one respect, however, the kingfish are desirable to the sportsmen. Small specimens can be used as live bait nearly as successfully as queenfish.

UMBRINA CUVIER

Synonymy:

Umbrina Cuvier, Règne Animal, 1817, ed. 1:297.

Diagnosis: Body moderately elongate, compressed; back fairly compressed and elevated; ventral side usually somewhat flattened; anterodorsal profile moderately steep. Snout rather bluntly rounded, usually fairly protuberant. Mouth moderate in size, subinferior, only slightly oblique; lower jaw included; exposed part of maxillary rather narrow; its posterior width 0.6 or less of eye. Suborbital area rather wide. Bony margin of preopercle finely serrate. Snout with slits and large pores; chin with single, thickish barbel and 4 large pores. Lateral line nearly concurrent with back. Dorsal and anal fins moderately high. Dorsal fins closely contiguous, their spines rather strong; about 10 spines in first dorsal; base of second dorsal more than twice longer than that of anal. Spines of pectorals and pelvics weak; those of anal more or less stout. Anal, II, 6 or 7. Caudal gently lunate to truncate. Scales, non-deciduous, rather large. Head scaly, except ventrally, and just in front of eyes and on lips, and also often on anterior portion of snout; its scales ctenoid, except on snout and sometimes below eyes. Teeth in both jaws closely set, in broad villiform bands; all small, pointed and slightly bent inward, except the outermost in upper jaw which are somewhat enlarged. Lower pharyngeals separate, moderately wide, with most or all teeth pointed, except in old specimens in which the strong teeth are worn down to rounded molars. Gill rakers more or less strong, rather short. Pseudobranchiae well developed. Air bladder large. Vertebrae, 10 + 14.

This genus comprises a fairly large number of species, most of which are American. Most of the American species occur on the west coast of the continent. Only one species is found in California, the remaining ones appear to be limited to the waters south of Cape San Lucas, Lower California.

FIG. 14.

UMBRINA RONCADOR JORDAN AND GILBERT

Yellowfin Croaker

Synonymy:

Umbrina undulata Steindachner, Ichth. Beitr., 1875, *3*:21; San Diego; not of Girard.

Umbrina xanti Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880:456; not of Gill.

Umbrina roncador Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, *4*:277; Pequena Bay, west coast of lower California.

Diagnosis: Lower jaw included. D. X-I, 26 to 29. A. II, 7. Chin with short fleshy barbel. Anal spines stout. Bright silvery, bluish above, with brassy reflections; no black spot at base of pectoral.

Description: Body usually deepest near anterior end of first dorsal but sometimes as far back as at posterior end of this fin; widest somewhere between bases of pectorals and posterior end of first dorsal; greatest depth, 3.5 (3.4-3.7); greatest width, 6.2 (5.3-7.0); small specimens often relatively narrower than large ones. Dorsal side usually distinctly more convex than ventral, but these sides may be subequally convex. Anterodorsal profile gently and often subuniformly convex, sometimes slightly concave above eye. Snout may be somewhat more or less produced than in figure 14; 3.3-3.6 in head. Maxillary reaches anterior margin or even slightly beyond middle of pupil; 2.9 (2.8-3.0) in head. Lower anterior edge of upper lip on level with a point about 0.5-0.8 of eye below lower margin of eye. Suborbitals, 1.0 (0.9-1.3) of eye; somewhat wider, relatively, in large specimens. Posterior margin of preopercle with varying number (10-24) of bony spines, increasing somewhat in size ventrally; dorsal ones hardly distinguishable, posteroventral ones of moderate size; along ventral margin as many as 12 bony spines may occur, but these are decidedly weaker than the posterior, frequently even hard to detect; in old specimens serrulation becomes weaker and may be nearly absent. Eye of medium size, relatively somewhat larger in small specimens; in specimens of 19-27 cm. body length, 1.5-1.8 in snout and 5.5-6.3 in head; in specimens about 36 cm. long, as much as 2.1 in snout and 7.4 in head. Snout with same number and arrangement of pores and slits as in figure 10A of *Roncador stearnsi;* however, inner 2 slits may be but slightly developed and lower middle pore often connected with margin by more or less developed slit. Chin with 2 pores on each side of barbel. First dorsal, X; first spine, 0.10-0.15 of second, which is 0.9 (0.8-1.0) of third, which usually is longest; remaining ones decrease in length posteriorly; posterior, 0.13-0.17 of third. Second dorsal, I, 27 (26-29); spine, 0.3-0.5 of first ray, which is subequal to second to sixth; remaining rays decrease in length posteriorly; posterior, 0.4-0.5 of longest. Pectorals, I, 17 (16-18); spine, 0.25-0.35 of first ray, which is somewhat shorter than second; third and fourth or fourth and fifth rays longest. Pelvics: spine, 0.6 (0.5-0.7) of first ray, which is longest and usually produced in fairly short, thread-like tip, which may be absent; bases of pelvics separated by about 0.7-0.9 of eye. Anal, II, 7 (last ray often split giving appearance of an eighth ray); first spine, 0.20-0.35 of second, which is 0.7-0.8 of first ray, which is longest; remaining rays decrease in length posteriorly; posterior about 0.4 of first. Caudal usually gently lunate, with dorsal lobe slightly the longer; may be symmetrical and truncate; with 17 well developed rays. 52 (51-54) pores on lateral line of body; 6 or 7 scales above, 13-15 scales below lateral line. Lower half of second dorsal scaly; and scales also extend a little onto base of anal.

Bands of teeth in upper jaw extend somewhat beyond middle of premaxillary, are of subequal width nearly throughout, and meet anteriorly or nearly so; in large specimens difference in size between teeth of outer row and inner teeth may be much less than in medium sized specimens. In lower jaw, bands decrease in width posteriorly and do not meet at symphysis; all teeth very small, subequal in size. Gill

rakers, 8 (7-9) + 12 (10-14); middle one, 0.33-0.40 of eye; in medium-sized specimens fairly strong, in large specimens tending to become very stout; decreasing gradually in length towards both extremities where they are very small, even hard to detect; on inside with double irregular row of fairly numerous fine teeth. On inside of first arch, 14 (12-15) knobs, each with numerous fine teeth; most knobs well developed but some of the distal may be quite small. Pharyngeals of about same shape as in figure 12G of *Genyonemus*. Most teeth of pharyngeal number 1 and many median teeth of lower pharyngeals fairly large and strong. Pyloric caeca, 6-8, of medium size. Air bladder lacks anterior horns.

Color bright silvery, with brassy and golden reflections; back bluish, ventral side light. Sides and back with numerous narrow, distinct, undulating streaks of deep olive that extend upward and backward, following rows of scales, sometimes alternating with rows of spots. Cheeks whitish. Fins mostly yellow. Gill cavity and peritoneum jet black; gill cavity sometimes only spotted with jet black.

A medium-sized fish, reaching a body length of more than 40 cm. (about 16 inches). Sport fishermen report specimens weighing over 5 pounds.

Proportions (in standard length):

Length of head	3.9 (3.7-4.1)
Distance from snout to base of pelvics	3.3 (3.1-3.5)
Distance from snout to vent	1.6 (1.5-1.7)
Distance from snout to anterior end of anal	1.5 (1.4-1.5)
Distance from snout to anterior end of first dorsal	3.2 (3.0-3.5)
Depth at posterior end of head	3.8 (3.6-4.1)
Depth at vent	4.0 (3.8-4.3)
Depth of peduncle	11.2 (10.5-12.5)
Length of first dorsal	4.6 (4.4-4.9)
Length of second dorsal	2.6 (2.5-2.7)
Length of pectorals	5.6 (5.2-6.1)
Length of pelvics	5.4 (4.9-6.0)
Length of anal	9.9 (8.8-10.9)
Length of caudal	4.9 (4.6-5.3)
Greatest height of first dorsal	6.6 (6.1-7.8)
Greatest height of second dorsal	9.3 (8.5-10.1)
Greatest height of anal	7.3 (6.9-8.6)

Measurements were made of 14 specimens of a body length of 19-27 cm. and of 1 specimen 36 cm. long. All the specimens were taken in southern California.

General Range: Coasts of California and of Lower California, from San Francisco (?) southward into the Gulf of California.

Occurrence in California: The species is common in southern California south of Point Conception. Its occurrence north of this point is extremely uncertain; in all events, it must be exceedingly rare. To the best of my knowledge, it has been recorded only once from these waters, viz., from San Francisco, where one specimen was collected by Jordan in the fish markets (Starks and Morris, 1907, p. 199). Of course, the fact that this specimen was found in a fish market makes it impossible to determine its point of capture with certainty; it may have been transported a long distance.

The yellowfin croaker usually occurs near the bottom in shallow water over sandy bottom, but it may fairly often be seen near the surface. It is often found in the surf along the open, sandy shores, but it is also to be found in shallow sloughs, and in the sandy Newport and San Diego bays it is sometimes very common.

It is seasonal in occurrence, being caught mainly in the latter part of the summer from July on. However, even during the winter it may occasionally be taken in its typical habitat. Nothing is known with certainty in regard to its migrations. The fact that it is more common close to the shores in the summer than in the winter may indicate that it migrates into somewhat deeper waters during the cooler seasons, just as the white sea-bass possibly may do. (See above, the corresponding section of the latter species.)

Food: This consists mainly of small fish and fish fry; but invertebrates, such as small crustaceans, worms and mollusks are also eaten in large numbers.

Breeding: Judging by the condition of the gonads in the specimens examined by me, breeding takes place in the summer months, i.e., during the time when the species is most common along the sandy beaches. The gonads are small from November until March, and they are large as late as in August. Maturity is apparently not reached until a body length of about 23 cm. is attained.

Commercial Importance and Sport Fishing: It is unlawful in California to take this species with nets (since 1909) and to buy or sell it (since 1915).

The species is taken the entire year, but at the same time it is characterized by a distinct seasonality. During most of the summer months, especially in the later part of the summer, great numbers of yellowfin croaker are caught by the sportsmen in southern California. On the other hand, during the cooler seasons the species is scarce. Most of the angling is carried on from the pleasure piers and from small boats fishing in comparatively shallow waters (10-20 feet) somewhat outside the zone of the breakers. Even though the species is taken principally just outside the surf zone, it is not common in the so-called "croaker holes," i.e., the depressions in the sandy bottom outside the breakers where the spotfin abound. In addition, the fish is also taken quite abundantly along rocky breakwaters (San Pedro) and in bays, especially in Mission Bay and Newport Bay; and it mixes with the California corbina to some extent. During the summer of 1937, quite large numbers of yellowfin croakers were caught on live bait from barges and party boats fishing two to five miles from shore in rather deep water. At the same time, surf fishermen complained of a scarcity of this species, although spotfin and corbina fishing was excellent. Was this event due to an unusual migration? Late afternoon and evening appear to be best for yellowfin fishing. The most commonly used baits are clams, mussels, pile worms, soft-shell sand crabs, and cut anchovy tails. Small live anchovy are also excellent. Most of the fish caught range from a few ounces to about two pounds but sometimes specimens weighing not less than about five pounds are recorded. Since the yellowfin is a splendid fighter as well as an excellent pan fish it is considered a prize catch.

MENTICIRRHUS GILL

Synonymy:

Menticirrhus Gill, Proc. Acad. Nat. Sci. Phila., 1861, *13*:86. (*Perca alburnus* Linnaeus=*Cyprinus americanus* Linnaeus.)

Diagnosis: Body comparatively elongate, little compressed; back moderately compressed; with moderately convex dorsal and ventral sides, ventral usually somewhat flattened; anterodorsal profile not steep. Head long, subconic; the bluntish snout considerably projecting beyond mouth. Mouth small, subinferior, nearly horizontal; lower jaw included; exposed part of maxillary rather narrow; its posterior width 0.5 or less of eye. Suborbital area wide. Membranous edge of preopercle serrulate. Snout with slits and large pores; chin with single, thickish barbel and 4 large pores. Lateral line nearly concurrent with back. First dorsal fin often quite high; second dorsal and anal moderately high. Dorsal fins closely contiguous, their spines rather feeble; about 10 or 11 spines in first dorsal; base of second dorsal more than twice longer than that of anal. Spines of pectoral and anal weak, spine of pelvic moderately strong. Anal I (seldom II), 7-9; caudal with lower angle rounded, upper sharp. Scales non-deciduous, moderate in size. Head scaly, except ventrally, and just in front of eyes and on lips; its scales ctenoid, except on anterior portion of suborbital and on snout. Teeth in both jaws closely set, in broad villiform bands; all small, pointed and slightly bent inward, except the outermost in upper jaw which are more or less enlarged. Lower pharyngeals separate, fairly wide, with teeth varying from sharp to very obtuse. Gill rakers short, tubercular, or obsolete. Pseudobranchiae well developed. Air bladder absent. Vertebrae, 10 + 14.

Menticirrhus includes a moderate number of species, all of which are restricted to American waters and about equally divided between the Atlantic and the Pacific oceans. The genus is strikingly restricted to warm waters, its only member occurring in California being the most northerly outpost on the west coast. In general appearance, the genus is one of the most easily recognizable of the family. This is, in all probability, in part associated with its type of habitat. All its members are true bottom dwellers, i.e., they live not only close to the bottom but they tend to rest on the bottom. Fishes of this mode of living, generally speaking, show a number of rather striking similarities which may be interpreted as adaptations to their environment. Their bodies are more or less depressed and frequently somewhat elongated, they have large pectoral fins which are used as balancers and for shuffling along the bottom, and they lack an air bladder, i.e., the organ by means of which fish regulate their position relative to the depth of the water. All of these features are characteristics of the genus *Menticirrhus*. The other members of Sciaenidae which are bottom dwellers usually do not rest on the bottom but swim around freely along or in the neighborhood of the bottom. Their bodies are, generally speaking, more or less compressed laterally, their pectoral fins are of moderate sizes, and all of them seem to be equipped with an air bladder.

Fig. 15

MENTICIRRHUS UNDULATUS (GIRARD)

California Corbina

Synonymy:

Umbrina undulata Girard, Proc. Acad. Nat. Sci. Phila., 1854, 7:148; San Diego, California, young individual.

Menticirrhus undulatus. Gill, Proc. Acad. Nat. Sci. Phila., 1862, *14*:17 (*nomen nudum*). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, *3*:456.

Diagnosis: Lower jaw included. D. X or XI-I, 23 to 27. Anal I (seldom II), 8 or 9. Chin with short fleshy barbel. Anal spine weak. Sooty grayish, with bright reflections; no black spot at base of pectoral.

Description: Body usually deepest at posterior half of first dorsal and widest at or just behind bases of pectorals; greatest depth, 4.6 (4.0-5.2); greatest width, 6.5 (5.8-7.3); small specimens often somewhat lower and narrower than large ones. Dorsal side often somewhat more convex than ventral, but these sides may be subequally convex. Anterodorsal profile gently and often subuniformly convex; sometimes flattened or even slightly concave above eye; and it may have a rather pronounced hump in front of eye. Snout somewhat variable, sometimes more, sometimes less projecting; 3.1 (2.9-3.3) in head. Maxillary extends to somewhere between anterior margin of pupil and a point 0.5 of eye in front of eye; 3.5 (3.3-3.6) in head. Lower anterior edge of upper lip on level with point about 1.0-1.6 of eye below lower margin of eye. Suborbitals somewhat wider, relatively, in large specimens; in a specimen of about 20 cm. body length, 1.25 of eye; in a specimen about 42 cm. long, 2.25 of eye. Along posterior margin of preopercle about 8-16 serrae, which always are rather small and increase but slightly in size ventrally; at least some of these have rather well developed ossification; serrulation along ventral margin but slightly, if at all, developed; in old specimens serrulation often nearly absent. Eye rather small, relatively somewhat larger in small specimens; in specimens of 20-25 cm. body length, about 2.0-2.5 in snout and 6.4-8.0 in head; in specimens about 40-42 cm. long, about 3.0-3.5 in snout, 9.0-10.0 in head. Snout usually with 5 fairly large pores arranged symmetrically in transverse row rather far from margin (see Fig. 16); beside these, there are 3 large pores closer to margin, also arranged symmetrically. Margin usually with 4 slits of which the 2 outer are connected with the 2 outer of the 3 pores near margin; of these slits, the 2 middle may be absent and an extra slit may connect lower median pore with margin. The 2 outer of the pores in upper row as well as lower median pore may also be absent. Chin with 2 pores on each side of barbel. First dorsal, X, seldom XI; first spine, 0.05-0.10 of second, which is 0.8 (0.6-1.1) of third; third usually longest; remaining ones decrease in length posteriorly; posterior, 0.10-0.15 of third. Second dorsal, I, 25 (23-27); spine, 0.3-0.4 of first four rays which usually are subequal; first ray may be slightly shorter than second; remaining rays decrease in length posteriorly; posterior, 0.3-0.4 of longest. Pectorals, I, 18 (17-19); spine, 0.3-0.4 of first ray, which is about 0.8 of second, which is 0.8-0.9 of third, which may be longest or slightly shorter than fourth and fifth. Pelvics: spine, 0.4-0.6 of first ray, which is slightly shorter to slightly longer than second and often has a short, thread-like tip; spine and base of first ray usually form a rather strong structure: bases of pelvics separated by 0.9-1.7 of eye; this distance larger, relatively, in large specimens. Anal, I (seldom II), 8 (seldom 9); spine, 0.5 (0.4-0.8) of first ray, which is 0.7-0.9 of second, which may be equal to or slightly shorter than third; remaining rays decrease in length posteriorly; posterior, 0.4-0.5 of longest; when 2 spines are present, the extra one is very short. Caudal with 17 well developed rays. 55 (52-60) pores on lateral line of body; 7 or 8 scales above, 20 (18-22) scales below lateral line. Second dorsal and anal scaleless.

FIG. 16. California corbina, *Menticirrhus undulatus* (Girard). Pores and slits around the mouth. Upper lip above; black crescent indicates the mouth; barbel seen between the right two and the left two pores of the lower jaw.

Bands of teeth in upper jaw extend somewhat beyond middle of premaxillary, are of subequal width nearly throughout and meet anteriorly or nearly so; in large specimens, difference in size between teeth of outer row and inner teeth may be decidedly less than in medium sized specimens. In lower jaw, bands decrease in width posteriorly and do not meet at symphysis; all teeth very small, subequal in size. Gill rakers, 6 (5-8) + 7 (4-10); difficult to count since they are replaced gradually by flat incrustations which tend to merge; those best developed are strong, knob-like, with a maximum length of about 0.25 of eye; all furnished with numerous fine teeth. On inside of first arch, 11 (10-14) knobs, each with numerous fine teeth; most knobs well developed but some of the distal may be quite small. Pharyngeals about as in *Genyonemus* (see Fig. 12G), but number 2 somewhat narrower and number 3 somewhat shorter. Most teeth of number 1, some of the anterior of number 2, and the median of the lower, enlarged but usually well pointed like the remaining ones. Pyloric caeca, 10 (8-12), rather large.

Color sooty grayish, with bright reflections; back and all fins dusky; undulating lines along sides running upward and backward, made of dark points in center of each scale; back also has these dark lines, but they frequently are not distinguishable on account of darkness of back; edge of opercle dusky. Lower side of head and body whitish in young specimens, but in larger specimens two dark stripes extend from head to tail, above pelvics and usually merging behind anal fin; these bands have been observed in specimens with a body length of only 28 cm. Lining of gill cavity slightly dusky; peritoneum whitish.

A medium-sized fish, probably reaching a body length of not much more than 46 cm. (about 18 inches). A specimen with a body length of about 16 inches weighed about 2.5 pounds. The length given above is based on values obtained by ichthyologists. Sport fishermen report specimens of about eight pounds.

Proportions (in standard length):

Length of head	4.0 (3.4-4.5)
Distance from snout to bases of pelvics	3.2 (3.0-3.5)
Distance from snout to vent	1.8 (1.7-1.8)
Distance from snout to anterior end of anal	1.7 (1.6-1.7)
Distance from snout to anterior end of first dorsal	3.3 (3.0-3.5)
Depth at posterior end of head	5.0 (4.6-5.5)
Depth at vent	5.2 (4.7-5.9)
Depth of peduncle	12.2 (11.3-13.2)
Length of first dorsal	5.0 (4.7-5.8)
Length of second dorsal	2.5 (2.4-2.7)
Length of pectoral	4.5 (4.2-4.9)
Length of pelvics	6.6 (5.9-7.9)
Length of anal	8.8 (7.9-9.6)
Length of caudal	5.4 (5.0-6.3)
Greatest height of first dorsal	6.1 (5.3-7.0)
Greatest height of second dorsal	9.5 (7.5-10.6)
Greatest height of anal	8.2 (6.8-10.3)

Measurements were made of 7 specimens with a body length between 19 and 29 cm. and of 8 specimens between 30 and 43 cm. All specimens were from southern California.

General Range: Coast of California and west coast of Mexico, from Point Conception to the head of the Gulf of California.

Occurrence in California: Common from Point Conception to the Mexican border. Stragglers may occur north of Point Conception but there are no certain records. It is a very pronounced bottom fish, preferring sandy beaches. (See above under the generic treatment.) Occurs not only along the open coasts but also in shallow bays. Extends down to a depth of about 20 feet.

Food: Mostly sand crabs (*Emerita analoga*) and other crustaceans; but other invertebrates are probably also used; see below, under sport fishing. Indeed, it appears to be the most important enemy of the sand crabs which occur by the billions in the surf zone, burrowing in the sand. In one of the specimens of this fish examined by me (its body length about 16 inches) not less than twenty sand crabs were found.

Breeding: The breeding season and the size at sexual maturity seem to be about the same as in the yellowfin croaker.

Commercial Importance and Sport Fishing: The California corbina has no commercial importance because, according to the present laws, it can not be taken with nets (since 1909), nor is it legal to sell or to buy this form (since 1915).

This species is decidedly wary. It sometimes can be seen in small scattered schools, swimming slowly along the bottom while seeking for sand crabs. When they feed in this manner, they very seldom take the bait; but on other occasions they may be caught in fairly large numbers by sportsmen. By and large, it is considered to be the most difficult sport fish in southern California, even though on some occasions it appears to forget all caution, taking the bait without hesitation. Thus, it may happen that while the skilled veteran has to leave empty handed, the beginner may make a record catch. This temperamental behavior, in addition to its fine fighting qualities, is perhaps the reason why this species is considered the most popular surf fish in southern California. In this region it corresponds to the striped bass in central California. Between Long Beach and San Diego, of a Sunday during the best season, there can be seen a continual row of surf rods, belonging to men who throw out their lines in the surf in the hope of catching this fish, but, alas, usually catching nothing but sharks and surf perch. The corbina may be taken the entire year around, but the summer season is by far the best. In addition, many sportsmen believe that the fishing is best at night. Some seem to think that soft-shell sand crabs furnish the best bait; but others prefer pile worms; and clams and mussels may also yield results. Long, fine gut leaders must be used. The species ranges up to six or eight pounds, but a three-pounder is considered an excellent catch. The corbina is a splendid table fish.

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